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WHAT HAS HAPPENED TO THE UNOBSTRUCTED BOWEL THAT FAILS TO TRANSPORT FLUIDS & GAS?*

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WHAT has happened to the mechanism of peristalsis when an unobstructed bowel fails to pass onward its contents? Is the intestinal muscle poisoned or injured, is it paralyzed or inhibited or is it still contracting in some incoordinated way? Before one attempts to answer these questions one must have some idea of the way in which food and its residues pass through the normal bowel.

THE MECHANISM OF NORMAL PERISTALSIS

It will be recalled that there are three main types of activity in the small bowel: first, local swaying movements or rhythmic segmentations which serve to knead the intestinal contents and to mix the food with the digestive juices; second, slow changes in tone; and third, peristaltic rushes which sometimes run from the stomach to the anus, carrying more or less material before them.

It should be remembered also that all these activities continue after degenerative section of the vagi and splanchnics, and that the first two and possibly the third continue even after removal of the bowel from the body.[4] Bits of intestinal muscle cut out and suspended in oxygenated Locke's solution will contract rhythmically for hours at a time, and the fact that they will sometimes beat more regularly on the third day after excision than on the first suggests strongly that nervous ganglia have little to do with the phenomenon.

Effects of Removing Nervous Inhibition. The digestive tract, then, is highly autonomous, so much so that it seems unlikely that a withdrawal of nervous stimuli could ever produce paralytic ileus. It is more probable that postoperative ileus would be produced by a stream of inhibitory stimuli arising in the brain or cord or in tissues cut and injured during the operation. In animals with the abdomen opened under salt solution, the bowel usually remains quiet until the distal two-thirds of the dorsal cord is destroyed or the splanchnic nerves are cut.

Rabbits with the vagi or splanchnics or both cut, and most of Auerbach's plexus degenerated, have such overly active intestines that many develop diarrhea and apparently die of inanition. The animals eat, but the stomach and cecum empty so rapidly that sufficient time is not allowed for digestion and absorption.

But even when the intestinal muscle is paralyzed or inhibited it is hard to understand why it should so completely fail to pass onward its contents. Alvarez has published records showing the seepage of fluids through the bowel in the absence of

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rush waves,[5] and dogs will go on living and digesting after the removal of all the muscle from long segments of bowel.[16,20,21]

What then goes wrong in cases of dynamic or paralytic ileus and what is the extra handicap that puts a stop to all movement of material through the bowel? Some observations we have made on the behavior of the excised digestive tract of rabbits suggest that this stoppage might be due at times to a tendency of the denervated bowel to cramp down and resist the passage of liquids and gas. This cramp-like contraction might be brought about not by an increase in nervous activity but by a decrease: a decrease similar to that responsible for spastic paralysis in arm or leg.

At other times the obstruction appears to be produced by gas which causes the bowel to become packed tightly in the abdominal cavity. Normally the innumerable kinks do not produce obstruction, because rush waves, traveling rapidly, push material ahead of them with such force as to distend the loops and straighten them; but as will be shown later, in sickly animals or animals with an abscess about the ileocecal sphincter, the rushes travel so slowly and hesitatingly that it does not take much to stop them.

Why Food Goes Caudad through the Bowel. Whatever the mechanism is that is responsible for the caudad progress of food, it must be built into the structure of every inch of the bowel because when short segments are cut out, turned end for end, and the continuity of the gut restored, the direction of peristalsis in the reversed segment remains unchanged; liquids can be forced through but solids will not pass; they accumulate at the upper anastomosis and eventually kill the animal by blocking the lumen of the bowel.[3]

Every segment, then, in a normal bowel is so constructed that peristaltic waves tend to go over it more easily in one direction than in another. The condition resembles that present in certain worms in which the "polarization" is so perfect that if the animal is cut into many small pieces they all crawl in the same direction toward the point where the head used to be.

Gradients. The next question is: What causes the polarization? Whatever it is it must be graded from the duodenum to the lower part of the ileum or it would not be demonstrable in every segment. Actually Alvarez and his associates, while studying the physiologic properties of intestinal muscle, found many graded differences in irritability, rhythmicity, tone, latent period, muscular strength, and metabolic rate. Their studies show that just as in the heart, so in the bowel, waves begin in the region of highest rhythmicity and run to the region of lowest rhythmicity.[3]

If these graded differences account for the direction taken by peristaltic waves, it follows that if the metabolic rate and the irritability of the ileum were to be raised in any way, as by the presence of inflammation, the gradient of forces might be so flattened or reversed that the bowel would transport material caudad no better than it ordinarily transports it orad. There might be active kneading movements in such a bowel but no more transportation of material than would be seen in a level ditch. Furthermore, if toxins of disease should injure the sensitive duodenum more than the hardy ileum, they would upset the gradient of forces by weakening the pumping power at the upper end.[6]

That irritation of the lower end of the bowel will slow the progress of material coming toward it was shown by Hedblom and Cannon, and White when they irritated the cecum by injecting into it a few drops of croton oil. It is well known that in acute ileus the bowel for some distance above the obstructed and highly irritated segment is empty; food residues are held back in the duodenum and jejunum, and if enterostomy is to do any good the opening must be made far orad in the region of the gut where material has accumulated. If on the other hand the obstruction is produced slowly and without irritation of

the muscle, as by a carcinomatous ring, the intestinal contents may pack up against the obstruction and, as we have seen in animals, it is the segment just above the block that is distended.

These observations are all explainable on the basis of the gradient theory and the law that Alvarez associates with it, namely, that irritation of the bowel at any point tends to hold back material coming down from above and tends to hasten the progress of material that has passed.[2] The rapid progress below an irritated segment will sometimes produce diarrhea, but often this hastening effect is obscured by the restraining action of the ileocolic and anal sphincters.

EXPERIMENTAL WORK

Several years ago Alvarez and Mahoney began work on the series of experiments here reported. They hoped to produce dynamic ileus or something corresponding to the reversal of intestinal peristalsis that is seen in acute appendicitis in man. In some of these cases, such large amounts of intestinal fluid are vomited at frequent intervals that there can be little doubt about the reversal of the gradient of forces in the bowel.

Unfortunately almost all the work done on ileus so far has been directed toward the elucidation of the cause of death, and the time has come when some attention should be paid to the disturbed mechanics of the bowel.

Crushing and Cutting the Bowel. Alvarez and Mahoney first opened the abdomens of rabbits under ether anesthesia and lightly crushed a segment of ileum in the jaws of a clamp. The lumen of the bowel was left unobstructed, and the abdomen was closed. A few hours later the animals were again anesthetized, the spinal cord distal to the fourth dorsal segment was pithed, and the abdomen was opened under a bath of warm salt solution. The bowel immediately above the injured and hemorrhagic band was generally found to be empty, and the only loops distended with fluid were found in the duodenum or jejunum. The bowel below the band was generally empty. At intervals, waves could be seen pushing material down toward the bruised region but as they approached it they either faded out or were met and blocked by short reverse waves.

The Injection of Irritants into the Ileocecal Region. Rabbits were anesthetized, the abdomen was opened, and a few drops of turpentine were injected into the wall of the bowel about the ileocecal sphincter. After an interval of from one to five days, the abdomen was again opened in a bath of warm physiologic salt solution and with the help of small wire clips and threads running to light levers, simultaneous records were obtained of the activity in six or more regions of the bowel.

The injection of the irritant material produced necrotic areas and small patches of peritonitis. The bowel for some distance above the injured region was empty and very irritable, and the duodenum and upper jejunum were commonly distended with a greenish fluid which they were unable to move onward. When the injury to the ileocecal region was sufficiently severe the animals suffered with diarrhea and the colon and cecum were empty.

In these animals the normal rush waves that from time to time run down the bowel either failed to appear or else were infrequent. Only with difficulty could they be produced with the usual method of injecting water into the mouth or esophagus. These rushes often faded out after going a short distance, or their advance was blocked by ring-like contractions which appeared here and there.

Normally, peristaltic rushes seem to gather momentum as they go, so that they travel faster in the ileum than in the duodenum. With a flattened gradient or one reversed at the lower end one would expect the rushes to travel more slowly than usual, especially in the lower part of the ileum, and actually such slowing was often a striking feature in our records.

In a number of animals there was little

sign of back-pressure. In some it was due to the fact that the lesion had not been made sufficiently irritating but in others the cause was not discernible. Perhaps in some the original gradient of forces down the gut was so steep that it could not easily be reversed, and it may be that such robust health can account for the fact that there are persons who in spite of the presence of such irritating lesions as a ruptured appendix can continue for several days to eat and digest with hardly a symptom of reverse peristalsis.

Occasionally reverse waves were seen to run orad a short distance from the injured region. These waves were particularly marked in an animal that had been pregnant and that aborted when the injection was made into the ileum. In this animal the back-pressure was so marked that at no time during the day could the distended duodenum empty into the jejunum. Even in the stomach the waves faded out before they reached the pylorus and some were reversed.

The local segmenting movements were sometimes active and sometimes quiet just as they are in "normal" animals.

For controls a few rabbits were etherized, the abdomen was opened, and the intestines were handled. A few days later when the abdomens of these animals were again opened the bowel behaved normally and many spontaneous rush waves were seen.

WHAT BRINGS ABOUT THE BACK-PRESSURE?

Having demonstrated that irritation of the lower ileum can produce back-pressure in the small bowel, with slowing or stoppage of peristaltic rushes, the next question was: What changes take place in the wall of the gut to explain the phenomena observed?

Rate of Rhythmic Contraction. The gradient in the rate of rhythmic contraction was reversed in only 2 out of 26 experiments. Apparently this gradient is not so closely related to some other basic gradient, perhaps of metabolism, as we once thought; and as we shall soon show, the irritability of the gut is probably a better index to the changes that take place in disease.

Irritability of the Bowel. We have found that normally the irritability of the bowel is graded from the duodenum to the ileum. The duodenum responds to the faradic current when the secondary coil is out 11 or 12 cm., while the ileum responds with the secondary coil at 9 cm. In the animals with the irritated ileum the whole bowel was unusually sensitive but since the increase in irritability was more marked at the lower than at the upper end, and since in some cases the duodenum lost in irritability at the same time as the ileum gained, the usual gradient down the bowel was reversed.

This reversal was the most striking and perhaps the most important observation made during the study. Its importance lies in the fact that it would probably be hard for waves starting in a comparatively insensitive region to travel toward a highly sensitive one.

Latent Period. When a muscle is stimulated it responds only after a certain interval which is called the latent period. Highly efficient muscles tend to have short latent periods while those that are less efficient and more sluggish generally have long latent periods. It was interesting, therefore, to find that in the normal animals there is a gradient with periods running from about 0.21 second in the duodenum to about 0.26 second in the ileum. It was interesting also to find that in the injured animals this gradient was flattened. The periods in the duodenum were about 0.18 second while in the ileum they were 0.21 second; obviously the presence of a sterile abscess around the ileocecal sphincter caused the ileum to be as irritable as the duodenum ordinarily is.

Conduction. When the bowel is stimulated at any point, waves of contraction run off in both directions but the one traveling downward with the gradient generally goes farther than the one travel-

ing orad against it. In the injured animals the rate of conduction was normal in the duodenum but slow in the ileum. This slowing was most marked in the waves traveling caudad. Ordinarily, in normal animals, it is twice as easy to demonstrate waves traveling caudad as it is to show them traveling 5 cm. or more orad. We thought perhaps that the flattening of the gradient might affect this ratio but there was no pronounced difference.

Behavior of the Excised Muscle. In order to differentiate in the animals with the injured ileocecal region the results of nervous inhibition from those of actual injury to muscle, segments from various parts of the bowel were excised and their behavior studied in warm aerated Ringer's solution. So far as rhythmic contraction went they behaved normally, the rates were normal and the amplitude good. The response to stimulation was practically the same as that obtained with segments removed from normal animals. Conduction is normally much easier to demonstrate in excised segments than in the intact bowel and the rate is doubled, possibly because inhibition has been removed. This was true also in the segments from the injured rabbits, except in the case of the lower part of the ileum which when excised responded to stimulation with measurable wavelets no oftener than it did in the intact animal. Possibly there was some injury to the ileum which showed itself in this way. Furthermore, in segments from the injured animals, waves did not travel out so far as they did in the segments from normal animals.

There was so little difference between the behavior of excised segments from injured and normal animals that we were driven to the conclusion that the failure of the bowel to pass onward its contents can hardly be due to injuries sustained by the muscle but is more probably due to nervous inhibition and to flattening or reversal of gradients.

Injury to the Ileum after Degenerative Section of the Vagi. The next problem was to determine if possible which is more important: nervous inhibition or upsets in gradients. It might well be that the back-pressure observed was due purely to inhibition produced at a distance by stimuli arising in the injured region. Since Johnson has shown that most of the myenteric plexus degenerates after section of the vagi we cut these nerves and after waiting three weeks, injected turpentine into the muscle of the terminal ileum.

Before doing this we had first to see how the bowel acts after vagotomy alone. It was found that after this operation the bowel becomes very active, probably because it escapes from control. Rhythmic contractions take place incessantly and rushes appear after the slightest stimulus.

Naturally, in such an animal with the brakes off and the bowel abnormally sensitive and active, one would not expect stimuli from the ileum to inhibit or stop the rushes as well as they would in a quiet and more insensitive bowel. This seemed to us to be the best explanation for our discovery that in these animals with most of the enteric nervous system degenerated a good many rush waves were seen. Most interesting is the fact, however, that as these rushes approached the ileum their progress was slowed even more strikingly than it was in animals with normal nerves. We were particularly interested in the marked slowing of the rush waves seen in the case of one animal in which both the vagi and splanchnics had been cut and allowed to degenerate. In this animal the only long nervous paths left probably went through the postganglionic sympathetic fibers which have their nutritional centers in the celiac ganglia. The fact that in spite of this handicap the lesion in the ileum was able to stop or slow down the rushes led us to conclude that flattened gradients did have something to do with the failure of conduction.

Gradients after Vagotomy. We first studied the various gradients in animals with vagotomy alone and found little significant change from normal. After

injection of turpentine the gradients of irritability and latent period were reversed or flattened much as they were in the animals with intact nerves.

COMMENT

We know from much work on normal animals that the opening of the abdomen under salt solution and the destruction of the spinal cord distal to the fourth dorsal segment constitutes such a strong stimulus to peristalsis that after a few hours the bowel tends to empty itself with repeated rush waves. When, therefore, in the animals with the terminal ileum injured we saw so few rushes, we felt sure that in the intact animal the transportation of material from stomach to colon must have been even slower. In some it appeared to have been stopped entirely and yet the lumen of the bowel was unchanged, the rhythmic movements were active, and the muscle was efficient.

It appears then that surgeons may have to find a new term for a type of ileus which is not due to mechanical obstruction or narrowing of the lumen of the bowel. It is not "paralytic" because the muscle is active and apparently in good working order, and it is not "dynamic" in the sense that there are none of those white, ring-like contractions that sometimes obstruct the bowel in children. The explanation that we offer for it is that there is a flattening or reversal of the normal gradient of forces and an excess of nervous inhibition. Perhaps until a better term is devised we may speak of a *flat-gradient ileus*.

Peritonitis. The next question that interests the surgeon is: What happens to the bowel when peritonitis develops? Do the toxins produced by bacteria injure the muscle, and if so, how long is it before this injury is irreparable? We have not as yet done any work on the bowel of animals with peritonitis but enough has been done by Hotz and Arai to give the surgeon some idea of what happens.

Hotz, using rabbits, cut open a loop of bowel, dropped it back into the abdomen and waited a day for the development of peritonitis. Then, after anesthetizing the animal, he made a small incision in the abdominal wall, drew out a loop of bowel and recorded its contractions in a bath of salt solution. He found that the muscle of such a loop would continue to contract rhythmically even when the peritonitis was so severe that the serous coat was covered with a thick layer of pus. Rhythmic contractions ceased only after the bowel had, for several hours, been distended with gas.

Hotz concluded, therefore, that injury to the muscle in peritonitis is due, not to toxins, but to distention by gas. The gas accumulates when absorption is impaired. As Usadel showed, distention of the gut closes not only the arterioles that bring necessary blood to the muscle but also the venules of the portal system, which normally carry the gas away as fast as it is formed.[3] It can easily be seen, then, that once gaseous distention and muscular paralysis appear, they are likely to get worse and worse through the formation of a vicious circle.

Arai[8,9] produced peritonitis in cats, generally by the injection of compound solution of iodine (Lugol's solution) but sometimes also by the injection of cultures of staphylococci and colon bacilli. He used a dose that in most cases would allow the animal to recover. He then gave a barium meal and watched the behavior of the digestive tract under the roentgenoscope. At the height of the peritonitic inflammation the progress of material through the bowel was slowed everywhere but in the proximal segment of the colon; there the feces traveled rapidly. The lumen of the bowel appeared to be widened so the tone of the muscle was probably a little low. The stomach was relaxed and its movements were slow. Rhythmic segmenting movements and rushes were seldom seen.

Arai next cut the splanchnics in a number of animals and after observing that in them peristalsis was more active and the progress of material through the

gut more rapid than normal he injected iodine or bacteria and produced peritonitis as before. To his astonishment he then found that in these animals peritonitis had no effect on the rate of progress of food down the bowel, and he was driven to the conclusion that all the slowing that he had seen before must have been due to nervous inhibition. Similar observations were made by Hotz.

These experiments of Hotz and Arai led them to conclude, then, much as we have done, that in some cases of ileus even with peritonitis, the intestinal muscle is still capable of active contraction and is only held in leash by nervous inhibition. In addition, conduction down the bowel may be made difficult or impossible by a flattening or reversal of gradients.

Methods of Treatment. The surgeon, being a practical man, will immediately ask how these conclusions are to influence his methods of treatment when he is confronted as he often is with the problem of restoring downward peristalsis and saving life. What has the physiologist to suggest?

Obviously the first thing to do would be to get rid of nervous inhibition. Some try to do this by using atropine but atropine is often unreliable and ineffective. Theoretically, nicotine would be an ideal drug because it blocks the passage of nervous impulses through sympathetic ganglia but it is highly toxic and will paralyze important ganglia in the brain at the same time that it is affecting those in the abdomen.

More promising of success are the efforts that have been made of late to block the splanchnics directly with procaine injected according to the Kappis technic, or indirectly with the help of spinal anesthesia.[18] Actually the results of therapeutic efforts along this line appear to have been in many cases very satisfactory. Even in cases in which peritonitis was present and severe enough to go on and kill the patient, bowel movements were for a time secured. Much of the literature on the subject has been reviewed recently by Ochsner, Gage and Cutting. Wagner, who was perhaps the first to induce spinal anesthesia for the cure of ileus, warned that it will not work if the patient is under the influence of morphine.

Pituitrin, especially when given in large amounts of physiologic salt solution, will stimulate peristalsis, but Judd tells us that in his experience it is as likely to do harm as good. Eserine does not appear to be reliable and its use has been given up by many who have tested it carefully.

Choline is a drug that now gives great promise of being useful to the surgeon. Much evidence has been secured by pupils of von Magnus to prove that it is a normal constituent of intestinal muscle and concerned in some way with maintaining peristalsis. We have tried it on animals and have found it to be an efficient stimulus to intestinal activity. The subject has been well reviewed by Magnus and von Klee and Grossmann. The drug must be chemically pure because it tends to break down into highly toxic substances. Merck and Kahlbaum supply it in ampules containing 600 mg. Put up in this way it will keep for several years.

For a man weighing 60 kg., the 600 mg. should be added to at least 250 c.c. of physiologic salt solution and run into a vein so slowly that the process will take at least seventeen minutes. If the patient is unusually sensitive he may complain of flushing, dyspnea, dizziness, and salivation, and the pulse will become slow. Under those circumstances the container should be lowered so that the drug will flow in more slowly. Good results were secured in many of the cases in which the procedure was tried. The surgeons in The Mayo Clinic have not yet used it enough to form any judgment as to its value.

The intravenous injection of sodium chloride alone serves as a strong stimulus to peristalsis, especially if the solution is hypertonic. F. Raine has told us of good results secured with injections of 50 c.c. of a 25 per cent solution and Coleman has advocated the use of a 3 per cent solution, 3000 c.c. of which is injected in the course

of twelve hours. McVicar tells us that in this clinic a 5 per cent solution has worked well.

According to Singer the bihydrochloride of quinine is a strong stimulant to peristalsis especially when injected into the rectum. Other drugs like sennatin, peristaltin, and isacen have been commented on favorably by German writers. A good review of the subject of intestinal stimulants will be found in an article by Vogel.

Restoration of the Normal Gradients. It will be a great day for medicine and surgery when the physiologist learns how to restore the normal steepness and direction of slope of flattened or reversed gradients. Perhaps then he will be able to restore appetite and to stop regurgitation, belching, vomiting, heartburn, nausea, and some forms of hiccup.

In animals the surest way in which to start peristaltic rushes is to induce swallowing by giving food or water; nothing else that we have tried works so well. We wonder therefore if the surgeon ought more often to use this physiologic stimulus. He might let the patient sip water or chew gum, or when a strong stimulus to peristalsis is desired, he might give the invalid a piece of meat which has been tastily prepared. Meat produces the greatest amount of psychic gastric juice; it probably has the most stimulating effect on the tone of the gastro-intestinal muscle; it is easy of digestion; its end products are promptly absorbed in the small bowel, and little is left from which gas can be formed. It is hard to see how such food could do harm, and in some cases it might well restore the steepness of the gradient of forces down the bowel and with it, normal aborad peristalsis.

Our experience with animals would incline us to caution the surgeon against distending or irritating the rectum with enemas. Especially when they are made irritating by the addition of much glucose they tend to reverse the gradient and to produce more back-pressure and reverse peristalsis. We have seen cases in which vomiting was almost certainly kept up by the use of such enemas.

The physiologist would advise the use of as little morphine as possible because in many persons it increases the tendency to reverse peristalsis. He would like to see the surgeon making more use of the barbital derivatives which in case of need can be given hypodermically. They do not upset gradients and because their action is more prolonged and more soporific than that of morphine, they give better sleep and they cut down on that nervous shock that may later lead to paralysis of the gut. To be sure when pain is severe they cannot take the place of morphine but they can keep the patient from asking for it so often.

Barbital, bromural or other similar soporifics should more often be given also on the evening before operation so that the patient will rest well in spite of strange surroundings and thoughts of the coming ordeal. Etherization appears to upset the gradients so that surgeons who make the greatest use of nitrous oxide and ethylene and regional anesthesia will probably have the least trouble with paralytic or flat-gradient ileus.[19]

We need hardly point out any longer the dangers of purgation immediately before operations. As Alvarez showed years ago this weakens the muscle and disturbs the mechanism that removes gas from the bowel. It is not yet so well known that purgation after operation is commonly unnecessary and only provocative of distress.[24] It should be used only when indicated and never as a routine measure. If the patient desires a bowel movement it can generally be secured with a harmless enema of physiologic salt solution.

Another suggestion that we would make is that the gas which so often is trapped in the splenic flexure might easily be thrown into the rectum from whence it could be voided, simply by lifting the patient's pelvis above his middle. The procedure is similar to that employed by a mother when she changes the position

of her baby so that the gas bubble in the stomach can float to the cardia and be belched. We have made some observations with the roentgen ray which show that this can be done and that it can immediately stop distress.

SUMMARY

The digestive tract is highly autonomous and the extrinsic nerves serve largely to prevent response to every stimulus. After vagotomy or splanchnicotomy peristalsis is often so active that the animal dies of inanition.

Normal aborad peristalsis appears to follow gradients of rhythmicity, irritability, latent period, metabolism, and muscular strength, running from duodenum to terminal ileum. These gradients might theoretically be reversed either by raising the irritability of the lower end of the gut or by depressing that of the upper end.

It may perhaps be stated as a law that irritation at any point in the bowel tends to slow the progress of material coming from the stomach toward it, and to hasten the progress of material moving caudad away from it. If the irritation is severe enough the result is an emptying of the digestive tract both ways from the lesion, with vomiting and diarrhea.

When, in rabbits, enough turpentine was injected into the tissues about the ileocecal sphincter to produce considerable injury, the animals suffered from diarrhea and the colon was emptied. The ileum was emptied orad and food residues were held back in the duodenum. Peristaltic rushes were few; they were hard to start, and they were slowed and stopped in the lower bowel.

The whole bowel was unusually sensitive to faradic stimuli, and in most of the experiments the normal gradient in irritability from duodenum to ileum was reversed. With the increased irritability of the bowel the latent periods were shortened, and the fact that this change was more marked in the lower ileum than in the duodenum caused the normal gradient (in latent period) to be flattened.

Segments of gut excised from the injured animals and placed in warm aerated Locke's solution behaved normally, showing that the failure of the bowel to pass onward its contents was not due to injury to the muscle.

Chemical injury to the ileocecal region in animals with vagi and splanchnics cut and much of the conducting system in the bowel degenerated still produced backpressure in the small bowel and marked slowing of rush waves. This suggests that the flattening of gradients had something to do with the failure of conduction.

The work suggests that in treating dynamic ileus attempts should be made first, to remove nervous inhibition, perhaps by splanchnic blocking or by spinal anesthesia, and second, to restore the normal dynamic gradient by giving food, and by avoiding morphine and irritation to the lower bowel. The various methods of inducing peristalsis postoperatively are briefly reviewed.

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PHYTOBEZOAR ASSOCIATED WITH GASTRIC ULCER

ESPECIAL REFERENCE TO PERSIMMON BEZOAR WITH REPORT OF A CASE*

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THE chief purpose of this paper is to review the subject of bezoars in general and of persimmon bezoar in particular, and to discuss the association of gastric ulcer with bezoar. Furthermore, a case of persimmon bezoar associated with gastric ulcer will be reported, and abstracts of 14 additional cases taken from the literature will be given.

BEZOAR IN GENERAL

Historical. The word "bezoar," derived either from the Arabian "badzehr" or from the Persian "pad zahr," signifying counterpoison or antidote, is a term applied to masses found in the intestines and stomachs of both men and animals. Bezoars were known as early as the twelfth century B.C. and were highly prized and sought after as remedies against poisons and pestilential diseases. Worn as charms they supposedly would protect one from all evil. Even up to the eighteenth century A.D., bezoars enjoyed almost universal confidence as remedies, and both the tincture and pulvis bezoardicus occupied prominent positions in the materia medica even if neither contained a trace of bezoar. They were more precious than gold and flagrant counterfeits were made. In order to save the public from itself Lonicer (1582)[4] made known some simple tests whereby fraud could be detected easily and effectively: (1) if a hot needle were inserted into a true bezoar, there would be no smoke; (2) if a poisoned man or beast were given a powder prepared from a bezoar and should survive, the bezoar was genuine; (3) if a sample of a true bezoar were mixed with water or saliva, it would color cloth. Bezoars of olden times probably were derived solely from animal sources; for instance, from sheep and goats. Fine distinctions were made between oriental and occidental bezoars. The former contained cholestrin, bile pigments and bile salts and on combustion diffused an aromatic odor and left no residue. The latter contained calcium and magnesium and on incineration left a residue.

Composition. Today, bezoars which are found in human beings are, from the medical standpoint, divided according to the predominating material of which they are composed: trichobezoar (pilobezoar, hair-ball), trichophytobezoar, concretion, and phytobezoar (hortobezoar).

Of all types, hair-ball is the most common,[4,18] Young women, otherwise sound in mind and body, occasionally become addicted to the habit of chewing and biting off the ends of their hair and trichobezoars are formed. As the name implies, both hair and plant matter form the second group.

Concretions are bezoars of the more solid sort. With few exceptions, they are composed exclusively of shellac.[7,9,25] These bezoars usually are found in painters and employees in furniture factories who drink furniture polish (a strong alcoholic solution of shellac) as a stimulating beverage. Subsequent ingestion of water precipitates the resins which accumulate in the stomach. Repetition of this process accounts for enormous masses, weighing up to 2000 gm., which have been found in the human stomach. Two cases have been reported

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in which the material of the concretions was not shellac. Kummant reported the case of a woman, aged thirty-seven years, who, twenty-three days after ingestion of a contrast meal of bismuth for roentgenographic study, underwent resection of the stomach for ulcer. A bezoar of pure bismuth carbonate was found and removed. When dried it weighed 40 gm. Woelffler and Lieblein cited Hamdi's case in which a Turk, aged fifty years, who had taken large doses of salol for cystitis, came to necropsy. In his stomach was found a glistening, crystallized bezoar of salol about 5 by 3 cm.

Phytobezoars are composed of vegetable material: stems, skins, fibers, or seeds. Other debris becomes included: starch granules, fats, fatty acid crystals, muscle fibers, elastic tissue and epithelium. Retention of plant matter by the human stomach, other than in cases of pyloric obstruction, is rare.

In the first recorded case of phytobezoar, that of Bucknill, which was reported by Quain in 1854, the mass was composed of string and cocoanut fiber. The patient was an epileptic man of twenty-two years, who was accustomed to eating gravel, dirt, rags and other debris, of which he ridded himself by diarrhea. Within twenty-four hours following an acute pain, and showing symptoms of peritonitis, he went to rapid dissolution. Necropsy revealed a perforation larger than a shilling on the lesser curvature of an otherwise healthy stomach, the lumen of which bulged with the 4 lb. mass the composition of which has been described. Cocoanut fiber, in addition to wood, figures in Hichens and Odgers' case. A woman, aged twenty-four years, complaining of pain in the stomach and of vomiting, and with a mobile epigastric tumor, was sent home with a belt and the diagnosis of floating liver or kidney. Subsequently she became very ill and passed two masses resembling pieces of door mat. A more complete history was obtained and abdominal exploration was advised. A cast of the same mat-like material weighing about 525 gm. and containing much fat, was removed from a structurally healthy stomach.

Occasionally unorganized plant material is found. Bryan, at gastrotomy on a Hindu, aged fifty-five years, removed, with the aid of sponge and spoon, a quantity of cellulose and other bits of undigested food. Hamdi reported 3 cases in men ranging in age from thirty to thirty-eight years, who under the stress of war and of flight from captivity, foraged in the open fields for periods from at least two to four weeks. Each developed loss of appetite, with corresponding loss in weight, along with postprandial epigastric pain, vomiting, and tumor formation. A bezoar of vegetable material was obtained from each one. The diets had included varying quantities of mallow roots, wild beets, couchgrass, parsley-like plants, and chenopodium roots, usually eaten raw. By rolling and coiling such plants in the hands, then keeping them for two days at incubator temperature in a digesting fluid of hydrochloric acid 0.1, pepsin 0.2, and water 100, Hamdi obtained material that exactly resembled that of the bezoars derived from the stomachs of these three men. In spite of the fact that much peeled rhubarb, black radish, kohlrabi, cragopon, acanthus and lettuce are eaten raw in his locality, to Hamdi's knowledge, such bezoars were never before observed.

Judging from the history of Schreiber's case, "schwarzwurzel" was implicated. This is a variety of salsify, which when cooked in butter, is eaten as a home remedy. He reported the case of a woman, aged forty-five years, who gave him the impression of being extremely neurotic, but presented, also, a movable tumor in the right side of the abdomen. A diagnosis of movable degenerating kidney was made. Enemas caused the mass to disappear for the time being; then it reappeared, but on the opposite side of the abdomen. Von Eiselberg then operated on her, with his diagnosis of carcinoma or movable spleen as a basis for the operation. A bezoar of

250 gm., with a circumference of 20 cm., was removed from the stomach. Several concretions were found at necropsy by Langenbuch. A large one from the stomach and a smaller one from 3 cm. below, in the intestine, were obtained from a subject who during life drank much "nussblätter tea." In the United States the more familiar materials found in phytobezoars are derived from the pumpkin, raisin, prune, celery and persimmon.

Etiology. The etiology of bezoars depends on no one particular factor. Positive factors seem to be the rapid satisfaction of a ravenous appetite by material suitably plastic for the muscular constrictions of the stomach to knead and mold it into a ball. There is reason to believe that they are formed at one time; layers of accretion are not found on section. If the formation of phytobezoars is dependent on a rich vegetable diet alone, the majority of vegetarians enjoy undeserved freedom from them.

Diagnosis and Treatment. Clinically phytobezoars are easily overlooked. The history and the roentgenologic study give the only reliable clues. The presence of a bezoar in an otherwise healthy subject has led to diagnoses ranging from floating kidney and movable spleen to polyp, adenoma and carcinoma of the stomach. Roentgenologically there should be no doubt as to the nature of the tumor. With a barium meal, the stream divides or pours over an object in the antral part of the stomach. The shadow of this object looks like an empty space or an air bubble; it is freely movable, and can be made to disappear and to reappear in various quarters of the stomach without pulling the wall inward. After the meal has passed into the intestine a barium-streaked object remains. Such bezoars float in a barium meal and sink as the barium separates out. Treatment usually is surgical.

BEZOAR AND ULCER

The association of gastric ulcer with foreign bodies of the stomach has been reported previously. Such ulcers also may occur from trauma to a stomach which has herniated through a defect in the diaphragm. That these ulcers are directly due to trauma has been proved beyond any reasonable doubt by the fact that they disappear following removal of the irritation. For example, in ulcer of the stomach associated with diaphragmatic hernia, replacement of the stomach and repair of the hernia, in the majority of instances, is followed by disappearance of the lesion. In 1926 Waller reported a case of a large hair-ball in the stomach associated with a large chronic ulcer of the posterior wall. At fluoroscopic examination the lesion was suspected of being malignant. However, the ulcer completely healed following removal of the hair-ball. In the case to be reported, the lesion had a punched-out appearance with considerable induration, and this, together with the fact that the patient had had symptoms for three or four years before he had eaten the persimmons made it probable that the ulcer had existed before the formation of the persimmon ball and was, therefore, not associated with it. Because of this it appeared safer to resect the stomach, including the lesion.

PERSIMMON BEZOAR

"Persimmon" is the American Indian[13] name of a native tree, the fruit of which first was described and praised by early explorers. De Soto (1539) and Jan de Laet (1558) mentioned it.[6] John Smith, in an account of the resources of the New World in the first year of the seventeenth century devoted a long description to it. Often called a plum, its fruit is a true berry, oblate to oblong in shape, with a diameter up to 5 cm. Its translucent flesh, ranging in color from yellow through orange to a dark red, houses as many as eight flat seeds.

Producers adjacent to large communities now have built up a considerable demand for the fruit, which, according to its Greek name, "Diospyros" (Jove's fruit), is fit for the gods. It is used in localities where

it is common (Fig. 1), in pone, ice cream, taffy and fudge, and in the preparation of home-made beverages. Evaporated in mass, it forms a "leather," which, when diced, is used on cookies and in pastries instead of citron or raisins.

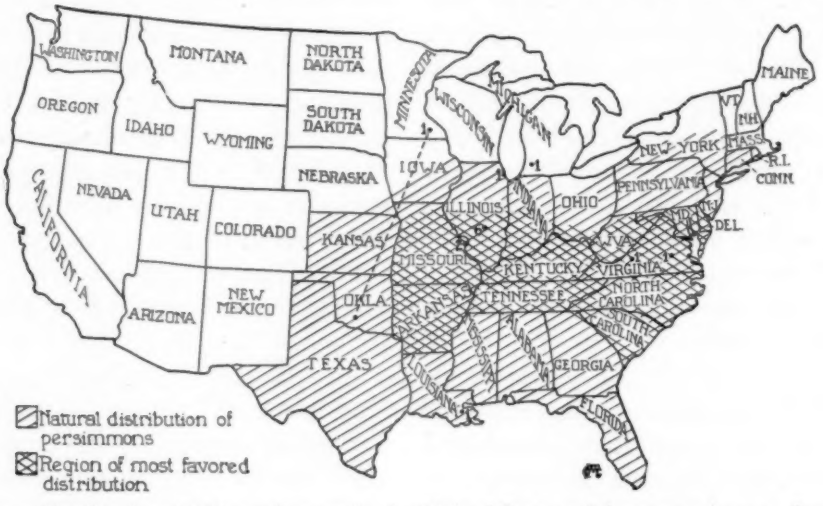

Fig. 1. Approximate distribution of the persimmon in the United States with source of cases of persimmon bezoar.

Fresh, ripe persimmons, eaten raw, seem especially to lend themselves to the formation of bezoars, apparently because even though their content of fiber is relatively low (4.3 per cent), their sticky juice and pulp contain 14.1 per cent gums and pectin. The quantity of persimmons eaten apparently has little to do with the formation of persimmon bezoars. There has been no question of lack of tone of the musculature of the stomach in patients in whom bezoars have been found; on the contrary, good, healthy muscle action appears to be one of the requirements for the formation of bezoars. Proper mastication, admixture with saliva and the custom of eating raw fruits with sugar and cream are mentioned as preventives of the formation of bezoars.

Symptoms of persimmon tumors usually take the form of an acute gastrointestinal upset within a few hours or days after the ingestion of the fruit. Nausea, vomiting, pain and diarrhea are present in varying degrees. There may be some fever. In the less severe forms, only a sense of epigastric heaviness or fullness, along with alternate constipation or diarrhea, may be the manifestations. Loss of weight and hematemesis are rare. Gastric ulcer may be associated. Occasionally symptoms may suggest disease of the gall bladder, angina pectoris, duodenal ulcer or carcinoma.

Although the standard treatment is surgical, simpler methods than surgical procedures have been successful in sporadic cases of persimmon tumor. Outten quoted King's account of a case in which, while the patient was awaiting operation, massage of the stomach was instituted, and after two weeks, the palpable tumor disappeared with the passing of seeds. Another case was cited by Outten, in which a male Negro gave a history of eating persimmons, and presented a circumscribed epigastric mass and suffered violent vomiting and had a fever of 104°F. The mass disappeared and seeds were passed within forty-eight hours under free catharsis. Even though digestants in the concentration found in the stomach have no effect on bezoars, Mills and Simpson, in a case in which there was achylia, administered dilute hydrochloric acid. In a few days hard dark masses of fruit skins and stems were passed; later roentgenologic study indicated that the mass was gone from the stomach. It is assumed that the acid stimulated proteolytic action by which the cementum of the vegetable detritus was dissolved.

Persimmon bezoars may be roughly spherical, cylindrical or conical in shape. In one instance, the bezoar assumed the shape of a half brick. They usually are about 5 by 8 cm. and one or more may be present. The surface shows the effect of attrition and may be marked with a velvety pattern by the mucous membrane of the stomach. Color may vary from dark brown, black, or greenish-yellow on the surface to a lighter shade within. At times, the outer crust may be carbonized or infiltrated with salts, and when seeds are present they project from the surface, making it very irregular in contour. A thin section microscopically may look like cork. Rolled and curled fruit skins may be recognized. A putrid odor, the sour odor of stomach contents, or an odor of fermenting fruit is given off. In a case reported by Peple the patient vomited pink fluid with a decided odor of fruit.

In the series to be reported, including our own case, 13 patients were males, 2, females. The age incidence was as follows: 1 patient was twenty years of age; 1 was in the age group from twenty-one to thirty years; 4 were in the group from thirty to forty years; 2 were in the group from forty-one to fifty years, and 7 were in the group from fifty-one to sixty years.

The most constant symptoms of the digestive upset were epigastric pain, nausea, vomiting and diarrhea. Time elapsing from the ingestion of the raw fruit to the recovery of the bezoar ranges from seven days to a little more than two years. Gastric analysis revealed all grades of acidity and anacidity from hyperchlorhydria to achlorhydria. Palpable tumor was present 5 times, was questionably present once, and 2 patients sensed a lump rather than felt it. Persimmon bezoar was associated with ulcer four times. Roentgenologic study disclosed a mass in 9 cases and the interpretation was correct in 4. Operations in the 15 cases included 15 gastrotomies, 2 gastroenterostomies, 1 enterostomy of the small bowel distal to gastroenterostomy, and 1 sleeve resection of the stomach; in 1 case gastrotomy was not performed and in 1 case it was performed twice. The gastroenterostomies were done for ulcer, resection of ulcer was done in 2 cases, and in the remaining 2 cases of the 4 with ulcer nothing was done for the ulcer. There were 12 recoveries, 2 immediate deaths from peritonitis, and 1 patient died three months later from tuberculosis which terminated postoperative pneumonia.

REPORT OF A CASE

A man, aged twenty-four, presented himself at The Mayo Clinic July 23, 1928 complaining of indigestion which had existed for a year and the chief symptom of which was "gas on the stomach." He had ignored this symptom until a month previously, when a dull pain had appeared along the left costal margin when the stomach was empty. The discomfort occasionally awakened him at night and always was relieved by eating. A week before he came to the clinic, a diagnosis of gastric ulcer was made by roentgen ray.

The patient was well developed and well nourished. One devitalized tooth, and enlarged and infected tonsils were present. There was more than moderate midepigastric tenderness. Urine analysis gave negative results. There was moderate secondary anemia; hemoglobin was 66 per cent and the color index was 0.8+. Results of other blood examinations were negative. There was moderate prostatitis, and Staphylococcus albus was cultured from the prostatic fluid. Gastric analysis performed on 50 c.c. of gastric content revealed total acidity equivalent to 66, and free hydrochloric acid equivalent to 42 c.c. of one-tenth normal sodium hydroxide. The roentgenogram of the chest was negative; that of the stomach suggested a perforating ulcer on the lesser curvature of the stomach above the angle and showed a central filling defect high in the stomach, apparently a benign tumor.

Abdominal exploration was performed by one of us (Balfour) July 28, 1928. A subacute gastric ulcer, with a crater 1.2 c.c. in diameter, was present on the posterior wall, at the angle. Within the stomach an unattached tumor about 7.5 cm. in diameter was palpable. A segmental resection of the body of the stomach, including the ulcer and intragastric

tumor, was done (Figs. 2 and 3). The tumor proved to be a bezoar, a soft, putty-like, bluish-black mass, weighing 60 gm. It was

FIG. 2. Wax replica of the persimmon bezoar.

nearly spherical, and its surface showed the effects of attrition. It crumbled easily, and there was exposed a brown, rather homogeneous interior, from which arose the not unpleasant effluvium of fermenting fruits. Seeds or pits were not present; certain bits were recognized as fruit skins.

On further questioning the patient recalled certain seemingly unimportant incidents. The duration of gastric distress probably was four years rather than one year. A year previously, while out hunting, he and his companions had come to a persimmon grove; all were very hungry and all had eaten freely. The patient devoured, according to his estimate, a quart of the fruit; he had never before, in all his life, eaten more than a cupful. A few days later he was ill, with nausea and a heavy feeling in the epigastrium. Recovery following operation was uneventful.

CASES FROM THE LITERATURE

Outten, in 1894, reported the case of a man, aged fifty-seven years, who had eaten persimmons and bread early in 1891. Several hours later he had experienced nausea and vomiting and had been sick ten days. In December, 1891 he had been hospitalized for nausea, and tumor of the stomach had been found. Two months later, in another hospital a hard nodular mobile tumor had been found. The diagnosis was floating spleen. Two gastrotomies were done for two bezoars

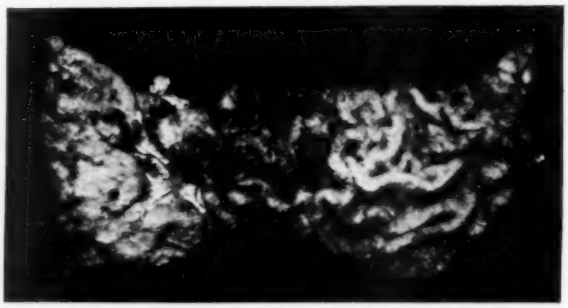

FIG. 3. Resected portion of stomach showing perforating ulcer.

weighing together 617.6 gm. Pneumonia developed on the eighth postoperative day and the patient died three months later of tuberculosis. Ten to twelve months had elapsed from the time the persimmons were eaten until the tumor was discovered.

Peple, in 1922, had as a patient a man aged fifty-two years, with epigastric distress, nausea, and a lump in the stomach. He complained of vomiting and of tasting fruit. Forty days before he had eaten persimmons, seeds and all. December 16, 1922, a palpable movable mass was discovered. Diagnosis by roentgen ray was of polyp or foreign body. Gastrotomy was performed and a bezoar, 8.75 by 7.5 cm., full of seeds and fibers, was removed. Recovery was uneventful.

Hart, in 1923, reported the case of a man, aged fifty-four years, who had eaten heartily of persimmons October 10, 1918. Six hours later he had suffered from vomiting, diarrhea, paroxysms of great pain and retching. A filling defect was found by roentgen ray in the pars media of the stomach. The diagnosis was pyloric obstruction. At gastrotomy, February 13, 1919, a foreign body composed of persimmon seeds and skins was removed. The man died from peritonitis. The duration of time from the eating of persimmons until operation was four months.

Another of Hart's patients was a man aged thirty-nine years. December 5, 1922 he ate 700 gm. of persimmons and some cranberry sauce. Four hours later he had severe epigastric pain and nausea, but no vomiting. The pain lasted for three to four days; then there was some vomiting of mucus and sour fluid. By roentgen ray a mass was observed. The

diagnosis was foreign body, probably persimmon tumor. Gastrotomy was performed January 13, 1923. A bezoar of persimmon seeds, skins, and other food debris, 7.5 cm. long, 5 cm. wide, and 3.75 cm. thick was found in the cardiac portion of the stomach. Recovery was uneventful. The time which elapsed between the eating of persimmons and discovery of the tumor was five weeks.

Hart also reported a case in a man aged forty years. He gave a history of occasional indigestion. He had eaten a large quantity of persimmons November 16, 1921. Soon he had been in considerable pain and he had induced vomiting and purging. This had given him relief. Diagnosis was not made preoperatively. At operation, November 23, a bezoar of persimmon seeds and skins, about 5 by 8 cm., was removed from the stomach. Recovery was uneventful. Seven days had elapsed in this case between the eating of persimmons and operation.

A man aged fifty-three years, a patient of Hart, gave no history of indigestion. November 3, 1919 he had eaten an unripe persimmon and in half an hour he had eaten two apples. Soon he had had epigastric pain, nausea and vomiting, and then severe diarrhea had begun which had lasted two weeks. He felt as if he had a ball in the stomach which should come out. He became constipated and had pain when his stomach was empty. The stools were black and the vomitus acid. Diagnosis was not made preoperatively. Gastrotomy was done January 28, 1920, and a bezoar of persimmon seeds and skins about 5 by 8 cm. was removed. Recovery was uneventful. He had some distress after eating and he was constipated. Eighty-one days had elapsed between the eating of persimmons and operation.

One of Hart's patients, a man aged thirty-five years, complained of stomach trouble which was exemplified by epigastric pain and eructation of sour material for eight years. Foods which were not acid relieved the pain. In November, 1921 he had eaten heartily of persimmons. In the night he had been awakened by severe epigastric pain and nausea, accompanied by vomiting of mucus. Then, on lying down, he had felt a lump in his stomach. He had vomited a considerable amount of blood once. Gastric analysis in terms of cubic centimeters of one-tenth normal sodium hydroxide was total acidity 74. Occult blood was graded 4. The clinical diagnosis was gastric ulcer and the diagnosis by roentgen ray, crater ulcer in the lesser curvature and mass in the pars cardica of the stomach. A bezoar of persimmon seeds and skins and other food debris, about 7.5 by 7.5 cm., was removed at operation. Recovery was uneventful. The period from the time the persimmons were eaten until operation was nine months.

Another man who came under Hart's observation was aged fifty-three years. He gave a history of many years of epigastric pain and distress coming on three to four hours after eating. The taking of soda and food had relieved him until one year before the present trouble. In November, 1920 he had eaten heartily of persimmons; he never before had eaten any of them. He had felt sick all over; purging had not relieved the pain, which had lasted four to five days and then had subsided. Attacks had continued until May 8, 1922, when he entered a hospital. A palpable mass was not discovered. There was hyperacidity. Roentgen-ray diagnosis was ulcer on the lesser curvature. A special diet for four to five weeks did not give relief and a malignant lesion was suspected. At operation, June 5, 1922, a benign ulcer was resected. Gastroenterostomy was done and a mass was not noted in the stomach. Recovery was uneventful and he was dismissed June 18, 1922. February 3, 1923, he had sudden, severe, epigastric pain that in three hours shifted to the umbilicus. The diagnosis was intestinal obstruction. At operation, February 5, 1923, a large foreign body was removed from the small bowel a few centimeters distal to the gastroenterostomy. The mass was cylindrical, 7.5 cm. long and 5 cm. wide. It was composed of persimmon seeds and yellow homogeneous matter. Recovery was uneventful. Three series of examinations by roentgen ray had not revealed the bezoar. Two years and two and a half months had elapsed from the eating of persimmons until operation.

Upson, in 1925, reported the case of a man aged forty-two years. He gave a history of indigestion of four to five years' duration exemplified by an inconstant sensation of heaviness after eating. For a few months he had had gnawing, burning pain three to four hours after eating. Gas in the stomach and eructation of sour material was relieved by food. The roentgen ray disclosed a free tumor in the stomach. At operation an oval bezoar, 5 cm. in diameter, composed of slices of fruit with persimmon seeds in the center, was removed. Recovery was uneventful.

Porter and McKinney reported, in 1926, the case of a man aged thirty-five years with a history of thirteen months of epigastric distress. In November, 1924 he had eaten freely of persimmons. A few hours later epigastric pain, nausea and vomiting occurred. Then for one week, he had an acute, severe, gastrointestinal upset with nausea, vomiting, diarrhea and epigastric pain. The diagnosis had been ptomaine poisoning. After the acute attack had subsided, he had experienced boring, epigastric pain one-half to two hours after eating. This had been relieved by taking food and soda. Examination revealed an emaciated patient with moderate anemia, with a mass about 5 by 8 cm. in the epigastrium. Gastric acidity, in terms of cubic centimeters of one-tenth normal sodium hydroxide was total acidity, 80 to 50 and free hydrochloric acid, 50 to 36. A foreign body in the stomach was disclosed by roentgen ray. The tentative diagnosis was persimmon ball. At operation, December 24, 1925, a bezoar weighing 59 gm. was delivered. Recovery was uneventful. The duration from the time of eating persimmons until the discovery of the tumor was thirteen months.

Larimore, in 1927, reported the case of a man aged twenty years. He had eaten persimmons one year previously. Constant epigastric distress had followed. He had had pain one to two hours after eating and at night. Occasionally the pain had been worse before eating and food had relieved it. There had been some nausea but no vomiting. Persistent belching had been present but there was no regurgitation. The bowels had been regular. There was no palpable mass. Gastric acidity in terms of cubic centimeters of one-tenth normal sodium hydroxide was total acidity, 56 to 57 and free hydrochloric acid, 27 to 42. A displaceable mass, about 5 by 8 cm., was revealed by roentgen ray. At operation, a bezoar of persimmon residue was obtained. Recovery was uneventful. One year had elapsed in this case between the eating of persimmons and the discovery of a tumor.

David, in 1928, had as a patient a woman aged fifty-nine years, with a history of constant epigastric pain for one year, which was worse at night. The pain was not related to the taking of food. She obtained relief by vomiting watery, brown fluid. Eighteen months before, while on a visit in central Illinois, she had eaten persimmons. From then on she had had trouble. There had been much loss of weight. The epigastrium was rigid with a questionably palpable tumor. Gastric acidity in terms of cubic centimeters of one-tenth normal sodium hydroxide was total acidity, 24 to 36 and free hydrochloric acid, 0. Roentgen ray revealed a penetrating lesion of the lesser curvature. The diagnosis was penetrating ulcer, probably malignant. At operation, October 4, 1925, a bezoar, 12.5 cm. long, 10 cm. wide and 7.5 cm. in thickness, composed of semisolid debris and persimmon seeds was recovered. There was a large, penetrating ulcer. Anterior gastroenterostomy with side-to-side anastomosis of the jejunum was made. Postoperatively the patient continued to vomit and refused food. October 25 jejunostomy was made. Death occurred five days later. Eighteen months elapsed from the time the persimmons were eaten to the time of the operation.

Maes, in 1928, reported the case of a man aged fifty-seven years. Following ingestion of persimmons and water he had had acute, cramp-like, abdominal pain. There had been no nausea or vomiting. Attacks of pain had occurred regularly at intervals of one to three weeks for the relief of which morphine was required. A free, mobile, upper abdominal mass was present. Diagnosis after examination by roentgen ray was probably phytobezoar. At operation a bezoar about 7.5 cm. in diameter, and weighing 386 gm. was removed. Recovery was uneventful.

Garrett, in 1928, reported the case of a man, aged forty-two years, who complained of a feeling of distress in the epigastrium, worse about one hour after eating. He felt as though there was a "lump" in his stomach, and that something seemed to block the passage of food at times. Roentgenologic examination of the stomach revealed an area of decreased density which could be moved freely to any part of the stomach. The patient stated that he had eaten freely of persimmons while hunting eight months before. Following a diagnosis of phytobezoar diospyri virginianae, gastrotomy was performed and a large, black cylindrical mass, 9.5 by 4.2 cm. and weighing 68 gm., was removed. The patient's convalescence was uneventful.

SUMMARY

A résumé of the bezoars is presented.

A case of persimmon bezoar associated with gastric ulcer is reported.

Fourteen similar cases from the literature are briefly reviewed.

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AN OPERATION FOR THE INDUCTION OF OSSEOUS FUSION IN THE ANKLE JOINT*

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As the entire weight of the body is transmitted through the ankle joint, mechanical or organic defects frequently induce permanent and serious disability. The rocking motion of the ankle joint should be conserved, when possible, but when there is only slight motion accompanied by persistent pain, a stiff ankle is preferable. In order to restore to approximately normal function an extremity so affected, the ankle joint must be eradicated and an arthrodesis or osseous fusion induced. This results in some inconvenience in walking on uneven surfaces; however, it is surprising how much compensation of function may be developed by increased motion in the subastragalar, midtarsal, and the tarsometatarsal joints.

The procedure is indicated in tuberculosis of the ankle in adults and following fractures or pyogenic infections which have eroded the articulation and caused an incongruity of the joint surfaces.

Tuberculosis of the ankle in adults may be arrested in a small percentage of cases by conservative measures, but comparatively few individuals can afford prolonged treatment, especially when the result of such measures is more or less uncertain. After a considerable period of treatment, adults frequently submit to amputation, whereas, if fusion of the articular surfaces could be induced, a useful limb will almost invariably be secured. In children there is a difference of opinino as to the advisability of operative fusion of any joint, but recent favorable reports of such measures in other joints suggest the possibility of attaining similar results in the ankle.

Pyogenic infections erode the articulation, and cause adhesions in the ankle joint by the organization of exudates and the formation of scar tissue. Fractures in close proximity to or involving the ankle joint may induce irreparable mechanical defects of the joint surfaces. Traumatic arthritis may cause similar reactions. Such lesions do not always cause persistent disability and the disability may be compatible with excellent function; however, when it is such as to impair seriously the efficiency of the individual, the fusion operation is indicated.

The routine operation for the purpose of inducing osseous fusion of the ankle joint consists of denuding the articulation of cartilage and approximating the osseous surfaces. The attempt is often followed by failure of the bones to unite, since it is difficult to approximate the bones accurately. Also, if the process is tuberculous, the latent infection may be relighted or a tuberculous focus elsewhere may be induced. Osseous fusion of all tuberculous joints should be accomplished, when possible, by surgical procedures which are extra-articular. In the ankle joint the extra-articular method is preferable, not only in tuberculosis, but also when there is incongruity from any cause. The procedure which will be described was suggested by 2 cases in which accidental and unintentional fusion of the ankle joint followed the author's operation for drop-foot.

TECHNIQUE

The operative technique is as follows: A longitudinal incision is made, beginning about 4 inches above the ankle joint and 1 inch internal to the fibula and continued

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downward over the lateral aspect of the ankle joint, terminating on a level with the superior surface of the external cuneiform bone. The superficial and deep structures are incised and the lower third of the tibia and the ankle joint are exposed. The superior surface of the neck of the astragalus is denuded. An osteoperiosteal graft about 4 inches in length is removed from the lower third of the tibia, thus denuding the lower third of the tibia. The graft, together with small bone shavings from the anterior aspect of the tibia is placed over the ankle joint in close proximity to the denuded surface of the lower extremity of the tibia and the denuded surface on the neck of the astragalus. A second skin incision 3 inches in length is then made over the posterior aspect of the ankle joint to the lateral aspect and parallel with the tendo achillis. Dissection is made between the tendo achillis and posterior capsule of the ankle joint, care being taken to retract the extensor hallucis tendon inward. The posterior capsule of the joint is incised transversely. The posterior extremity of the astragalus and the cartilage from the posterior portion of the ankle joint are removed. The posterior aspect of the tibia just above the ankle joint is denuded. A mass of bone is removed from the superior surface of the os calcis and placed in contact with the denuded posterior surface of the tibia and denuded surface of the os calcis. An osteoperiosteal graft may also be placed on the posterior aspect. Both wounds are then closed and a plaster cast, extending from the toes to just below the knee, is applied, holding the foot in slight equinus position.

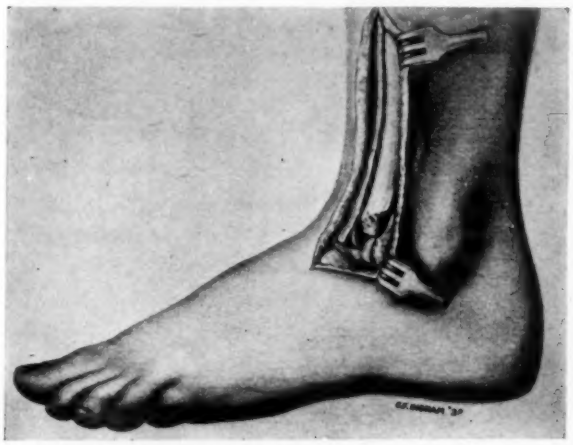

Fig. 1. Anterior lateral incision showing exposure of anterior aspect of ankle joint with osteoperiosteal graft in contact with denuded surfaces of tibia and astragalus.

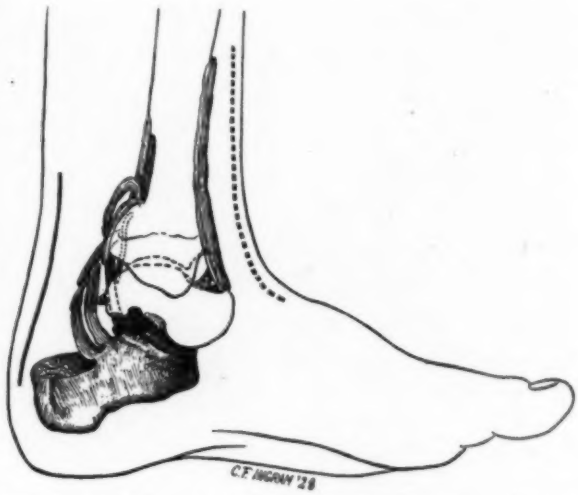

Fig. 1A. Schematic drawing showing location of incisions and technique of application of graft.

Fig. 2. Posterior incision showing exposure of back of ankle joint and bone chips obtained from posterior surface of tibia and os calcis.

The equinus position greatly facilitates walking and, to some degree, compensates for the lost rocking motion of the ankle joint. The graft may be taken from the opposite limb when the quality of the bone on the affected side is defective.

The cast should be worn for at least three months, after which a brace is applied. A plaster model of the foot and leg is made from which a leather corset is constructed and reinforced with steel bars, so that complete immobilization is secured. In this apparatus weight is permitted, but the brace must be worn until fusion is solid. Fusion, after any operation on the ankle joint, results only after an elapse of considerable time. This is probably due to the fact that there is no natural circulation between the articular surfaces, as between the two fragments of a fractured bone.

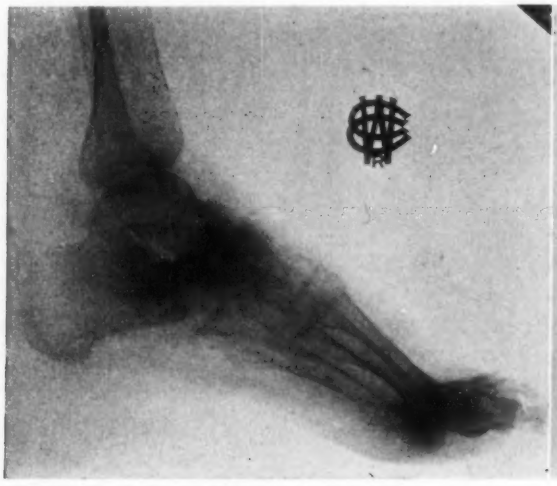

FIG. 3. Roentgenogram of Case 1, showing destruction in astragaloscaphoid and calcaneocuboid joints.

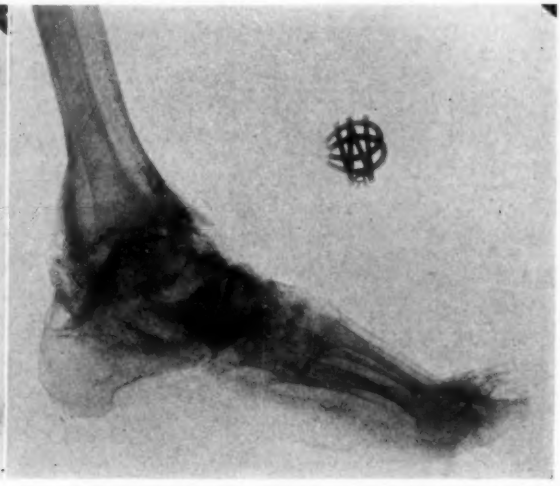

FIG. 4. Roentgenogram of Case 1, eighteen months after arthrodesis, showing solid fusion of the ankle and midtarsal joints.

CASE REPORTS

CASE I. Tuberculosis of the right ankle. A woman, aged sixty years, was first examined August 31, 1926. Nine years before she had injured the ankle by falling. The joint remained painful on use and two years previously a cast had been applied and worn for a short time. The ankle was moderately swollen and tender on pressure over the head of the astragalus, scaphoid and cuboid bones. The entire foot and ankle were held rigid, but there was no hyperemia or fluctuating. The roentgenogram showed destruction and erosion of the calcaneocuboid and astragaloscaphoid joints. The cuboid bone was almost completely destroyed and the bones of the entire foot and leg were osteoporotic. The Wassermann test was negative and the general examination was essentially negative.

A molded leather brace was applied and walking advised with gradually increased weight-bearing. Heliotherapy was also prescribed, but the symptoms increased in severity. April 24, 1927, an extra-articular fusion of the joint was performed, including the midtarsal joints. From tissue removed from the joint at the time of the operation tuberculosis was diagnosed. The foot was immobilized in a cast for three months, after which time walking was permitted in a brace. The result was excellent. A year and a half after the operation the arthrodesis was completely solid, the foot in good weight-bearing position, and the patient was able to walk without pain.

CASE II. Tuberculosis of the left ankle. A woman, aged thirty-five years, was examined April 10, 1926. At the age of ten years the patient sprained the left ankle. Pain and swelling persisted and gradually increased. An abscess formed which ruptured spontaneously and there was a daily elevation of temperature for a period of over three years. The symptoms then subsided and remained quiescent until the patient was twenty-seven years old. At that time persistent pain followed a mild injury and the foot was immobilized in a cast for six months. Since that time the pain had gradually increased in severity and for three months, preceding the examination, walking was possible only with crutches. The roentgenogram revealed an old destructive arthritis of the left ankle joint. The articular surfaces of the tibia and astragalus

were eroded, the body of the astragalus was flattened and all bones of the foot showed osteoporosis. The Wassermann test was negative. On May 6, 1926, an intra-articular fusion of the joint was performed, denuding the articular surfaces of the joint. The wounds healed, but throughout the subsequent period of eighteen months pain persisted and bony fusion did not occur. A second operation by the extra-articular method was advised and performed October 24, 1927. The tibioastragalar joint was refreshed, the subastragalar and midtarsal joints denuded of cartilage and an osteoperiosteal graft from the tibia placed across the joint anteriorly and chips of bone from the os calcis and tibia placed posteriorly. The wounds healed promptly and on January 12, 1928, the cast was removed and an ankle brace fitted. Fusion occurred rapidly; by October, 1928, the arthrodesis was solid, the foot was in good functional position and the pain had been entirely relieved.

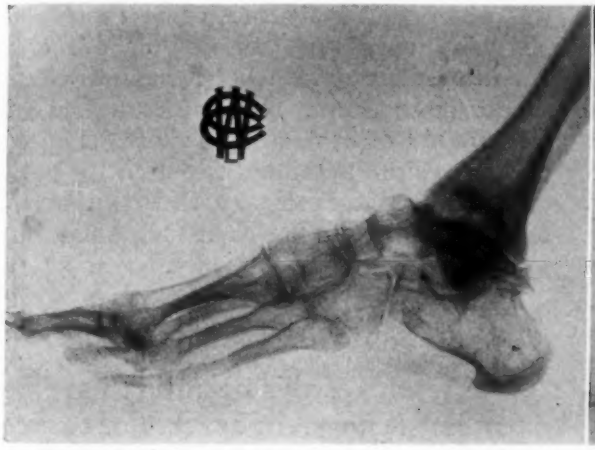

Fig. 5. Roentgenogram of Case II, showing erosion of ankle joint and flattening of astragalus.

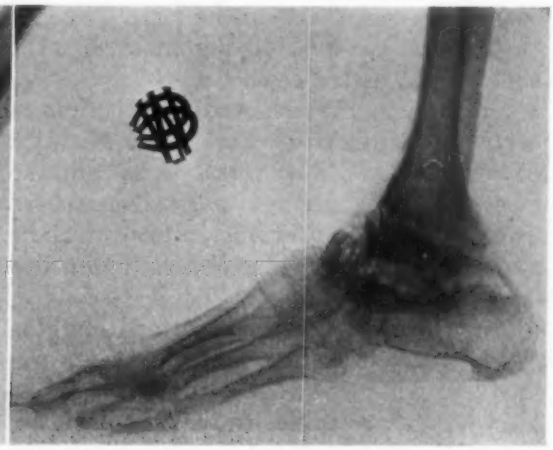

Fig. 6. Roentgenogram of Case II, after extra-articular fusion, showing solid union.

Case III. Infectious arthritis, left ankle. A man, aged forty-two years, examined May 11, 1927, was complaining of swelling of the left ankle. He had bruised the ankle June 12, 1925, when his foot slipped off the clutch pedal of an automobile. Two incisions for drainage had been made, but no pus was formed. A month after the accident a cast was applied which he wore for five months. The swelling persisted;

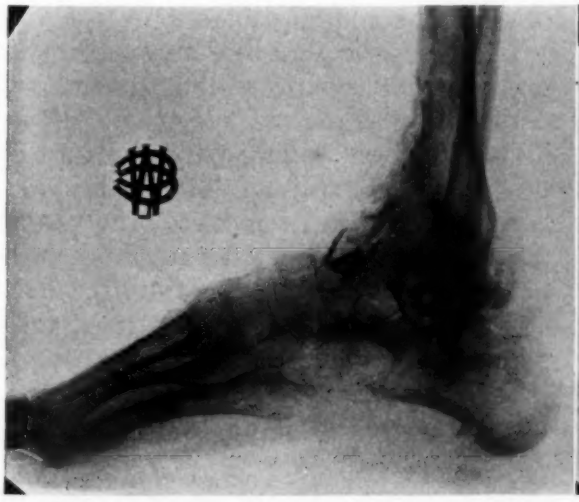

Fig. 7. Roentgenogram of Case III, after extra-articular fusion. Note proliferative changes in bones and calcaneal spur.

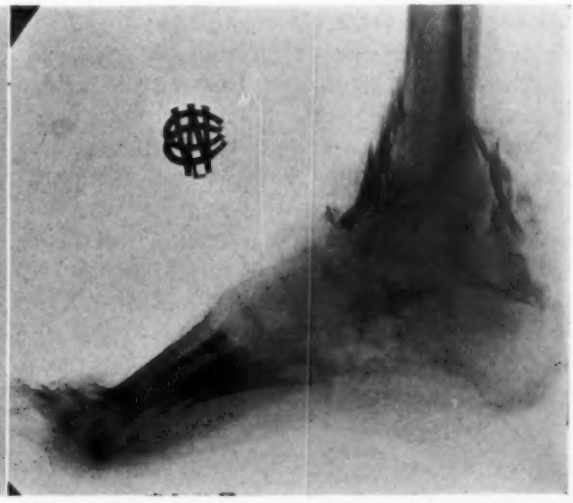

Fig. 8. Roentgenogram of Case IV, after arthrodesis. Note density of grafts in comparison with atrophic bones and beginning callous production.

the joint was stiff and painful on weight-bearing. The ankle was enlarged, the muscles of the calf were atrophied and there was tenderness on pressure over the internal malleolus. No motion was demonstrable in the joint. The foot was in good weight-bearing alignment, but the patient walked with a cane.

The roentgenogram showed destruction of the articular surfaces of the left ankle with apparent ankylosis. The tarsal bones showed osteoporosis and there was a spur on the os calcis. There was a previous history of acute gonorrheal urethritis. The Wassermann test was negative.

A fusion operation was performed on February 2, 1928, following which a cast was applied and worn until May, 1928, and subsequent to that an ankle brace. The result is excellent. When last seen the arthrodesis was practically solid.

Case IV. Tuberculosis of the left ankle. A woman, aged thirty years, was first examined March 7, 1928. The joint had been painful at varying intervals since she had sprained it in May, 1927. For four months the pain had become insidiously and progressively worse and for two months she had been unable to bear her weight on the left foot. The joint was swollen, the local heat was increased, there was tenderness over the anterior surfaces of the joint and over the internal malleolus. Passive and active motions were limited. The roentgenogram demonstrated a narrowing of the joint space, an erosion of the articular surfaces and osteoporosis of the bones. The Wassermann test was negative. An extra-articular fusion operation was performed on March 8, 1928, using two osteoperiosteal grafts from the opposite tibia, one of which was placed anteriorly and one posteriorly to the joint. When the joint was exposed at the time of the operation, the capsule was found distended, the synovial membrane congested and the fluid was seropurulent in character. Microscopical examination of a specimen of tissue from the synovial membrane was not definitely conclusive of tuberculosis, but was highly suggestive. Following the operation the wounds reopened and discharged a thin serous fluid. The sinuses healed sufficiently after eight months to allow the application of an ankle brace and to permit the patient to begin weight-bearing. The arthrodesis, at the present time, is not completely solid, but is apparently progressing rapidly.

DISCUSSION

The results of this operation have been most satisfactory. In tuberculous cases a period of six months is required before osseous fusion is complete. The most favorable time to induce fusion in tuberculous joints is in the early stage or in the residual stage, after the disease has subsided. When the process is active, with extensive destructive changes, osseous reaction is at a low ebb and there is grave danger of exaggerating the already active process or of causing secondary infection.

It is possible that the anterior incision and the osteoperiosteal graft may be omitted and that osseous fusion may be induced by employing only the posterior route. However, if an osseous bridge on both aspects can be induced, the result is more certain. In those in which there has been no evidence of tuberculosis, there is no reason why the joint also may not be denuded, as an additional security, but this is rarely necessary.

THE QUARANTINE IN ABDOMINAL SURGERY*

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THE quarantine in abdominal surgery implies the setting apart of a segment of the abdominal cavity so that peritoneal absorption and subsequent morbidity may be limited. The peritoneal cavity is a closed lymph sac which has facilities for absorbing large quantities of fluid very rapidly. A virulent infection generally distributed over the peritoneum is absorbed into the circulation with amazing rapidity. Hence, the ominous significance of the term "general peritonitis."

Most of the preparation of the food which sustains life is done within the gastrointestinal tube. Great activity and freedom of motion is necessary for the proper functioning of the organs constituting this tube. The free movement of these various organs or parts of this canal on each other is made possible by the peritoneum. It secretes a fluid which acts as a lubricant and thereby permits these movements without friction. The introduction of any agent which injures the peritoneum results in adhesions and limits these movements. Every effort should be made to limit the absorbing area of peritoneum exposed in case of infection and also to limit the area of morbidity which may result from such infection.

The quarantine principle is nature's own plan for accomplishing this and the peritoneum is the most efficient of all the body tissues in furnishing material for rapid construction of a quarantine wall. The peritoneum has the faculty of secreting or pouring out most efficient reparative material in great quantities when emergencies arise. For instance, if the appendix becomes infected or gangrenous, the peritoneum begins at once to secrete fluid which contains not only leucocytic warriors to fight the infection but plastic material for building a wall around it. Loops of bowel, omentum or any other movable intra-abdominal structures within reach of the involved area are brought to the field and cemented together by the thickening of this lymph. If the parts can be put at rest and the infection is not too aggressive, the area is soon effectively quarantined. Likewise, when an infection of the uterus extends into the tubes, or through the uterine wall, lymph is poured out in the neighborhood, which soon thickens and seals the ends of the tubes to the ovary or to other peritoneal tissues in the neighborhood. Intestines surround the pelvic organs and help to form the structures of a quarantine wall. Hence, it has long been known that the most important medical treatment of an infective or traumatic abdominal condition is production of absolute rest by every available means so that an effective quarantine wall may be constructed with the least possible interruption. To this end, food is kept out of the stomach, the stomach is washed, fluids are supplied in some other way, and peristaltic movements are stopped by large doses of opiates. Any foreign body introduced into the peritoneal cavity, or any traumatized area in which the normal epithelial lining of the peritoneum has been destroyed, is immediately quarantined in the same way.

Many times efforts of nature are entirely successful in quarantining a serious source of infection and are usually successful in healing a traumatized area. When nature fails, the aid of a surgeon is required. Nature may entirely fail, may be but partially successful or may leave bad after-results. In the case of a large source

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of infection, such as follows perforation of some of the abdominal organs, for example the stomach or duodenum, nature

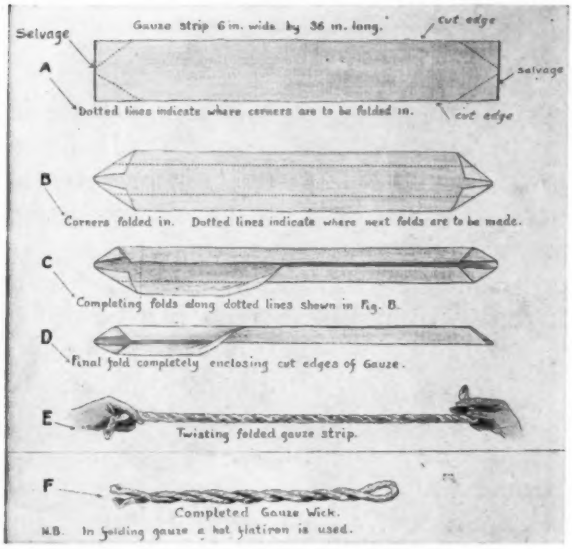
Selvage
Gauze strip 6 in. wide by 36 in. long.
cut edge
A
selvage
Dotted lines indicate where corners are to be folded in.
cut edge
B
Corners folded in. Dotted lines indicate where next folds are to be made.
C
Completing folds along dotted lines shown in Fig. B.
D
Final fold completely enclosing cut edges of Gauze.
E
Twisting folded gauze strip.
F
Completed Gauze Wick.
N.B. In folding gauze a hot flatiron is used.

FIG. 1. Preparation of gauze wicks.

is usually inefficient. If the infection or invading enemy is limited in quantity but is very aggressive, as is the case in perforating appendicitis, nature's efforts to form a quarantine may be thwarted unless augmented by measures to stop peristalsis. When nature has been successful, usually a very strong wall is formed by an excessive amount of reparative material. The tissues within the enclosure of this wall often become necrotic and an abscess may be formed which may later be drained. After such repair, adhesions represent the residue of reparative material which has not been absorbed after the need for the wall has passed. These adhesions may result in troublesome morbidity.

The weakness of nature in defending herself is that she has no way of mechanically disposing of an enemy except to starve it or absorb it. Therefore, her first action is always to quarantine it. The primary function of the surgeon is to remove the infection or offending body from the abdominal cavity by mechanical measures or to repair the traumatized area. Many times it is not possible for the surgeon to remove the source of infection entirely or to repair the diseased area completely. In such case, it becomes his duty to establish a surgical quarantine of this diseased, infected or traumatized area. By a proper quarantine, he may separate or segregate the diseased area entirely from the rest of the peritoneal cavity. In thus quarantining the disease, he is able also to drain the quarantined area separately, for this segment is extraperitoneal in effect.

The importance of the quarantine principle was recognized by Mikulicz more than thirty years ago when from a thickness of gauze he made a sac into which he packed long strips of gauze laid in the sac back and forth like the folds of a fan, thereby interposing a large pack of gauze between the free peritoneal cavity and the diseased area. When it was desired to remove the pack, it was only necessary to withdraw this long strip of gauze which had been folded in the sac, thus leaving the empty sac as the only part of the drain in actual contact with the peritoneal surfaces. The late Joseph Price of Philadelphia, also Deaver, was very fond of using these large packs of gauze. In that stage of the development of abdominal surgery, this form of drainage properly used was a great life saver but it had serious drawbacks. The large amount of gauze within the abdomen produced an outflow of serum in proportion to the amount of surface of peritoneum thus contacted by the gauze. The relatively small piece of gauze coming out through the wound was soon blocked by the discharging debris. As a result, a large quantity of serum often accumulated around the gauze. Therefore, extensive adhesions were likely to follow such a drain. Furthermore, the removal of the sac containing the gauze strip sometimes broke down the plastic wall which nature had formed around it.

As modern surgical technique developed, the crudeness of this form of drain became more and more apparent. The pendulum swung to the other extreme, so that such able authorities as the late John G. Clark

of Philadelphia and Yates of Milwaukee brought out very convincing experimental evidence to prove that abdominal drainage should be largely abandoned. Gauze drainage within the abdomen practically passed out of use, chiefly because it had been improperly used, for I think no one now would think of using gauze drainage directly in contact with intestines or omentum, except in rare emergencies.

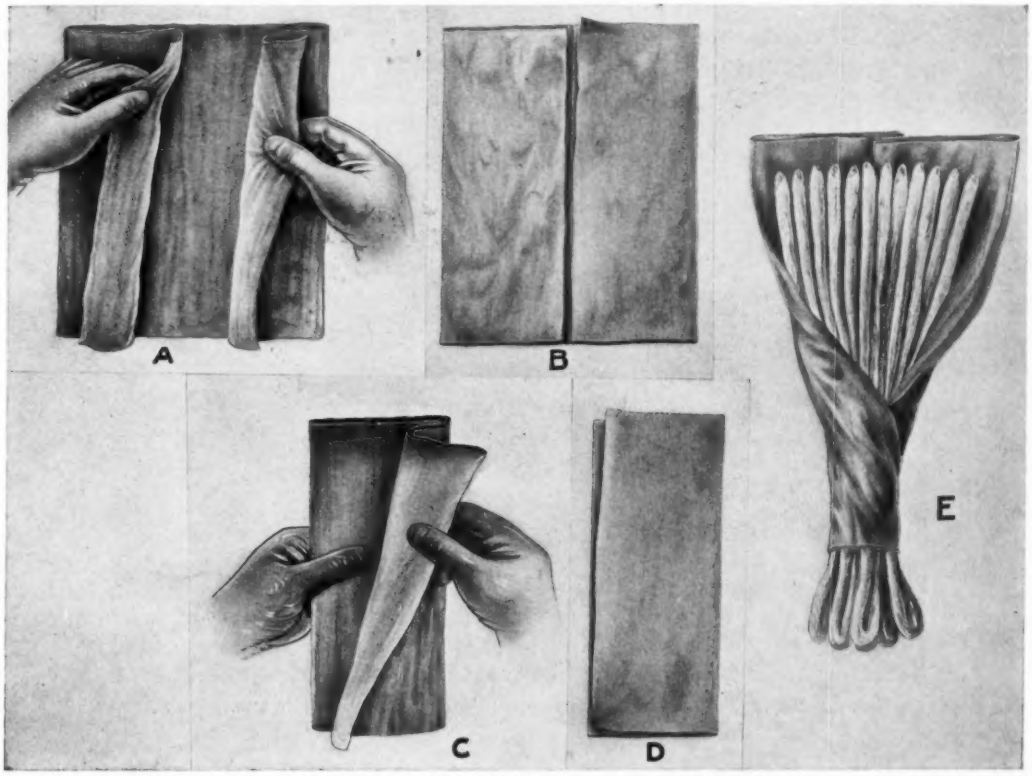

Fig. 2. Preparation of gutta-percha tissue. *a*, *b*, *c*, *d* folding gutta percha. *e* Structure of quarantine. Relation of gutta percha to wicks.

About twenty-five years ago it was my fortune to do a great deal of my surgery in private houses in remote districts in which there were no trained nurses and relatively few doctors who had an adequate conception of asepsis or the after-care of abdominal cases. It was necessary to take a surgical nurse and all the equipment necessary to do an aseptic operation. Not the least important and hazardous part of such an operation was the after-care with the surgeon often far away. I soon learned that it was advisable to drain in every case in which there was any excuse for drainage because this greatly reduced the postoperative anxiety.

The Mikulicz drain was gradually abandoned and in the place of the large gauze pack was substituted a drain made up of a number of small wicks of gauze laid straight and altogether surrounded by sheets of rubber tissue. This greatly simplified the matter and made it safe for the local physician or nurse attendants to remove the wicks at the end of the first week and to remove the rubber tissue a week later. The results in these cases were so remarkably good as regards immediate mortality and postoperative morbidity, that the rationale of this particular type of drain became the subject of a good deal of experimental research and study. As the years went by, opportunity came for re-opening in cases in which this type of drain had been used, with the amazing revelation that there was almost a total absence of post-

operative adhesions, in direct contrast to results following the ordinary small tube drain or cigarette drain. Analysis of the mechanism of the drain brought forward the fact that its principal merit was that it was not simply a drain but a quarantine which segregated the diseased area from the remainder of the peritoneal cavity. Such a structure to be workable must possess the following qualities:[1]

1. The surface on the side of the general peritoneal cavity must be smooth and inoffensive to the abdominal organs coming in contact with it.

2. It must remain accurately in place.

3. It must provide ample drainage of the infected or injured segment.

4. It must be so constructed that it may be removed with the least possible trauma.

The first requirement is met by the use of an outside rubber tissue covering. The second is met by carefully arranging gauze wicks around the infected area. The gauze, being porous, rapidly fastens itself to the tissues where it is placed and thus anchors the quarantine. The third (ample drainage of the segregated area) is provided by gauze leading to the surface. Fourth, this gauze must be arranged in small wicks laid straight so that one may be withdrawn at a time without disturbing the defensive wall that nature has placed around the quarantine.

FIG. 3. Placing of wicks in quarantining pelvic organs.

A very important detail is the construction of a wick that is strong and that at the same time has no ravelling edges. Such a wick is made from strips of gauze 5 or 6 inches in width, cut across a 30 inch bolt of gauze following a drawn thread. We have used Seabury and Johnson's Monitor gauze because of its strength. The steps in constructing this strip into a wick are shown in Figure 1. It will be seen that the ends of the wicks are formed by the two selvage edges of the bolt of gauze. All the cut edges are securely turned in and ironed with a flatiron and

[1] While all the principles of this quarantine have been used for twenty-five years in literally hundreds of cases and the quarantine has been roughly described in other articles on drainage, the full illustrated technique for the preparation and application of the quarantine was first published in *Annals of Surgery*, 85: 808, 1927.

the wicks twisted. The two ends are then brought together and again twisted. Six of these double wicks are placed in a package for sterilization. When unfolded for use, the two ends of the wick are untwisted from each other, but the pressing and twisting used in the preparation prevents the wick from unfolding and exposing the raw edges. When put into place, each wick is laid separately, bringing the middle or loop to the surface. After the loop is cut, the two ends left in the wound make two wicks to be removed. Twelve wicks of this kind are sufficient for holding a quarantine in place and

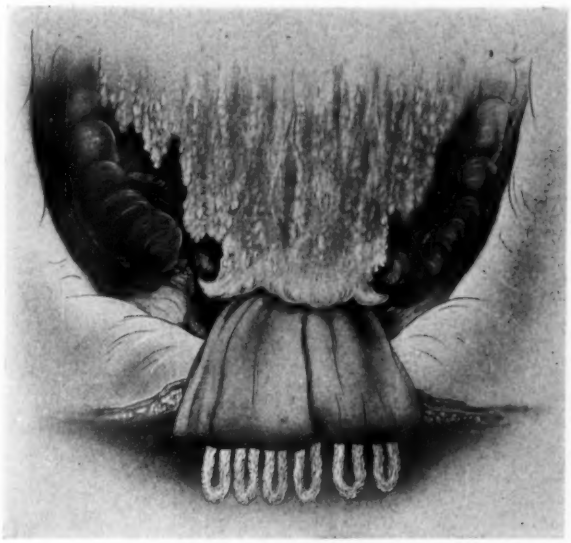

Fig. 4. Quarantine in place, showing two folds of gutta percha separating wicks from intestines.

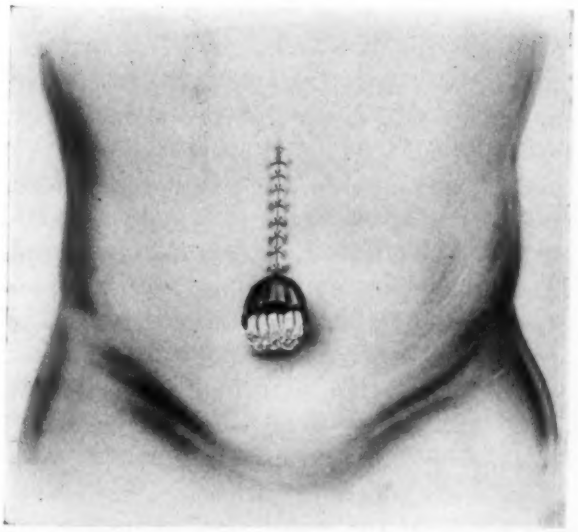

Fig. 5. Quarantine emerging through abdominal incision as large cigarette drain.

Fig. 6. Quarantine with wicks in appendix abscess cavity surrounded with gutta percha and leading from posterior wall to abdominal wound through peritoneal cavity.

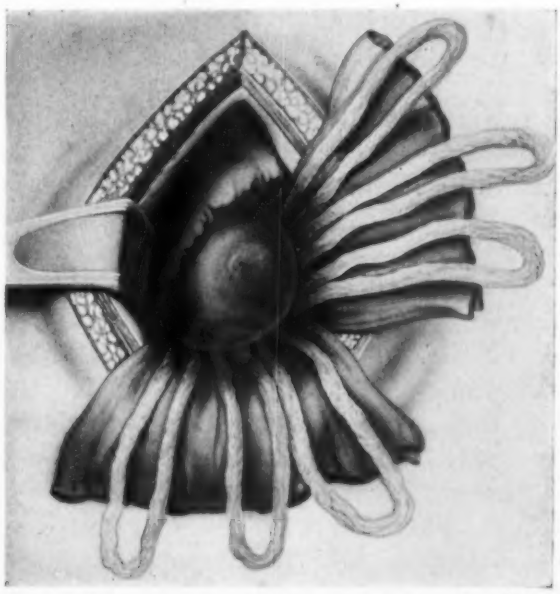

Fig. 7. Under local anesthesia, abdomen has been opened, intestines packed away and wicks placed in contact with posterior parietal peritoneum in front and back of gall bladder. Rubber tissue sheets placed external to it. Gall bladder is first aspirated, then split, contents removed. Opening in gall bladder left open either with or without drainage tube. Used in case of serious septic infection of gall bladder in feeble or seriously ill patient.

draining the area. When these twelve wicks are massed together, brought to the surface and surrounded by four thicknesses of rubber tissue, a made-in-cigarette drain approximately an inch in diameter is the result. The lower end is spread out in the shape of a fan (Fig. 2*e*) to surround the area to be quarantined.

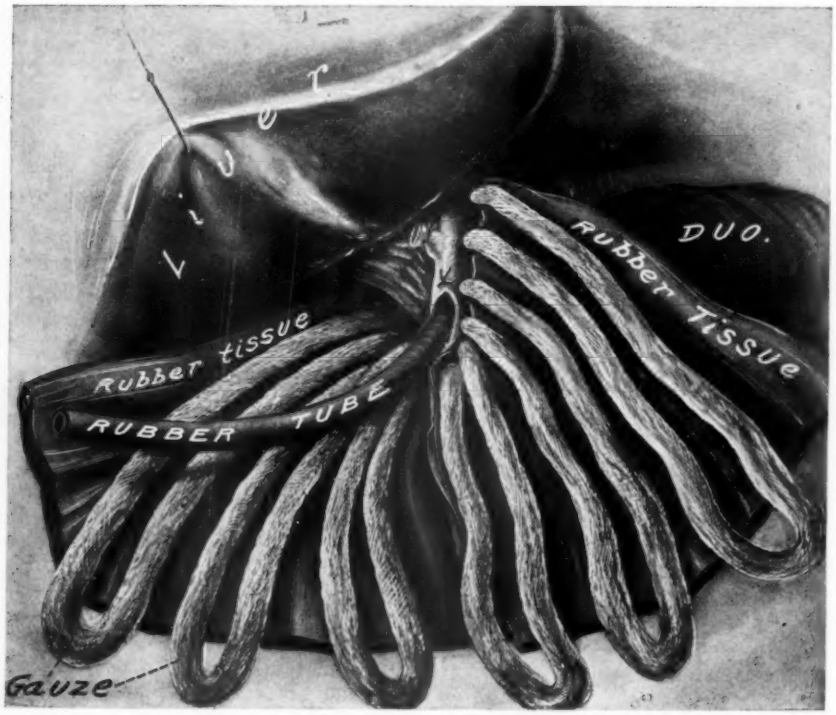

FIG. 8. Septic gall bladder has been removed, common duct has been split and emptied of stones, pus and other debris. Three double wicks are placed at entrance of foramen of Winslow external and posterior to duct. Three double wicks have been placed internal to duct. Two sheets of rubber tissue placed to surround wicks.

The gutta-percha covering is constructed as follows: Seabury and Johnson extra-heavy tissue is used. It comes in bolts 5 yards long, 36 inches wide. This bolt is cut longitudinally into three strips 1 foot wide by 5 yards long. Each strip is cut in 18 inch lengths making ten pieces of tissue 12 by 18 inches. Each piece is folded in its long dimension to four thicknesses, making a four-ply sheet of rubber tissue 12 inches long, 4½ inches wide, in which all cut edges are turned in, leaving none but folded edges exposed. By this method of folding, the greatest strength of the gutta percha fiber is longitudinal and therefore the sheet will not tear transversely. Aseptically the gutta percha is prepared and preserved as follows:

Gutta percha, after it is cut in the desired length, is put in 1:1000 bichloride and allowed to stand over night. It is then dried with sterile linen and folded, making it ready for use. It is kept in a glass jar which has been autoclaved or boiled. This is done with sterile gown and gloves.

It is easier to apply a rubber tissue covering in two pieces of 4½ inches' width than in one of 9 inches' width. Therefore, two pieces are always used, three if necessary to cover in the gauze effectively.

Meticulous care in the placing, as well as removing, of the quarantine is important. With long-handled forceps, the tip of each wick is placed where it is to remain in arranging the quarantine as shown in Figure 3. After the wicks have been laid straight, the sheets of four-ply gutta-percha tissue, described in Figures 2 and 4, are arranged so as to separate the gauze from the free peritoneal cavity. As the

quarantine passes through the abdominal wall, the rubber tissue completely surrounds the gauze forming a cigarette drain at this point which is spread out so as to surround the quarantined area at the bottom. The abdominal wall should not be drawn too tightly around the drain. The wicks are removed one at a time one week after they are placed. This may be done without anesthesia but a light gas anesthesia, lasting only a minute or two, is preferable. No force should be used in removing these wicks. With a pair of thumb forceps, each wick is pulled upon lightly to determine which one may be removed with least force. One week after the wicks have been removed, the sheets of gutta percha are easily removed altogether without gas. No other drainage is inserted after the gutta percha has been removed.

Speaking in terms of general principles, we have the following indications for the use of the quarantine in abdominal surgery:

1. Infected organs which tend to produce a peritonitis by contact or discharge but which organs are not to be removed.

2. Intra-abdominal abscess so located that the wall is exposed to the intra-abdominal viscera and where the discharge must be conducted across the free peritoneal cavity after drainage is established.

3. An open viscus which because of the presence of infection or for other reason it is impractical or undesirable to close at the time.

4. Large denuded bleeding or infected areas where it is impossible to cover with peritoneum.

5. Extensive recurrent adhesions which distrub the function of abdominal organs.

The specific indications for the quarantine are:

1. After operations for pelvic accumulation of pus (Figs. 3, 4, 5).

2. Septic infection following miscarriages and criminal abortions. Fever and other evidences of infection disappear almost magically after introduction of the simple quarantine.

3. Acute gonorrhoeal salpingitis in the early stages while pus is exuding from the ends of the tubes but before the tubes have sealed firmly. Quarantine stops pertionitis

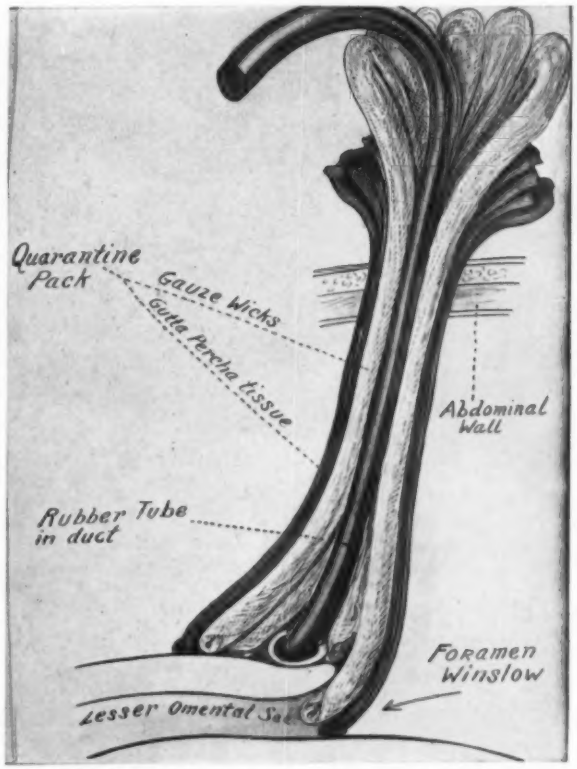

Fig. 9. Quarantine in place, showing section of quarantine as it passes through abdominal cavity from back to front.

and relieves symptoms immediately. We have never had to reoperate upon a case if the quarantine was placed before the tubes were sealed.

4. Extensive pelvic adhesions in which great disturbance is produced by attachment of the intestines to the pelvic organs. Cutting and separating the adhesions followed by the interposition of a quarantine gives most gratifying results.

5. Postoperative ileus in which the intestines have attached themselves to the pelvic organs the first two or three postoperative days. A quarantine placed early, separating the intestines from the pelvic organs, gives immediate and complete relief.

6. In a well-formed appendix abscess beneath the end of the cecum in which it is necessary to drain through the free perito-

neal cavity, the ends of the wicks are placed in the abscess cavity and the end of the rubber sheets extending farther down surround the abscess cavity and the gauze. Postoperative intestinal obstruction which follows the small cigarette drain in such cases is practically unknown if the abscess cavity has been quarantined. (Fig. 6.)

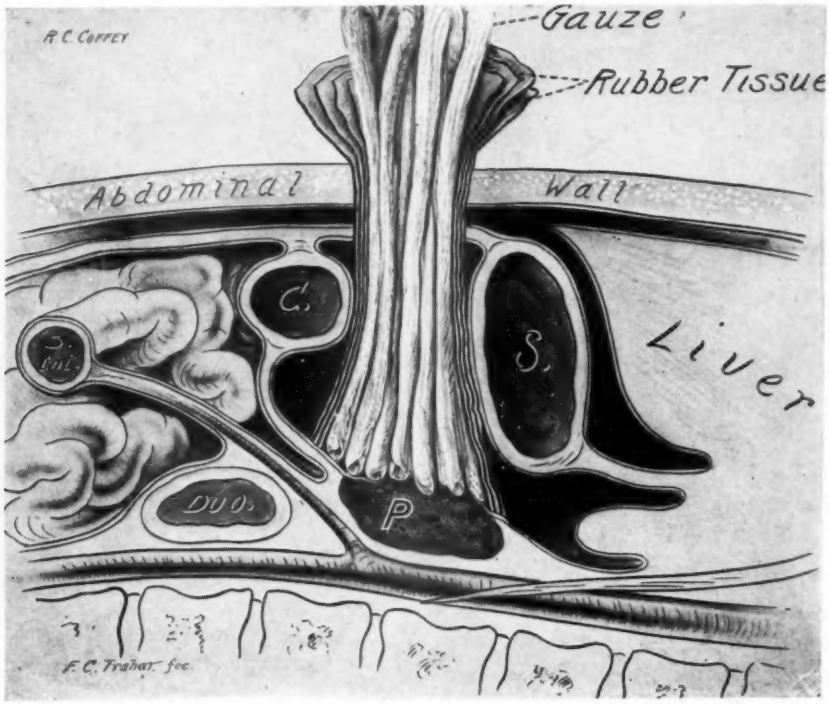

FIG. 10. Drainage of ruptured pancreas or in pancreas drained for acute pancreatitis.

7. Septic or gangrenous gall bladder occurring in the aged may be quarantined and the gall bladder emptied under local anesthesia with relatively no shock to the patient. (Fig. 7.)

8. Common-duct operations in which there is pus in the field or in the ducts. A tube in the proximal duct with a quarantine surrounding the hole in the duct, and the area generally, effectively removes any danger of immediate infection and leaves a postoperative field remarkably free from adhesions. (Figs. 8 and 9.)

9. Quarantine is well adapted to surround a field from which a septic gall bladder has been removed.

10. Quarantine is very efficient in preventing the reformation of adhesions which have occurred after a gall-bladder operation.

11. Our greatest success with rupture of the pancreas or acute pancreatitis with fat necrosis has been to push back the peritoneum covering the pancreas, place gauze wicks in contact with the denuded pancreas, surround the wicks with rubber tissue producing the quarantine. The drainage passes through the entire depth of the abdominal cavity without producing fat necrosis of the tissues as it passes through.

12. To surround two parallel intubated ends of intestines which have been brought out through a septic wound as an emergency and which are later to be closed by the Mikulicz plan.[1]

13. To hold back intestines from screened radium which has been placed within the abdomen for the treatment of cancer which cannot be entirely removed surgically.[2]

[1] See *Annals of Surgery*, June, 1927, article on Application of the Principle of the Quarantine in "Abdominal Surgery," Figs. 17 and 18.

[2] See *Northwest Medicine*, March, 1927, article on "Treatment of Cancer," Fig. 1.

14. Quarantine with multiple wicks is the only system of drainage which has been successful in the operation which

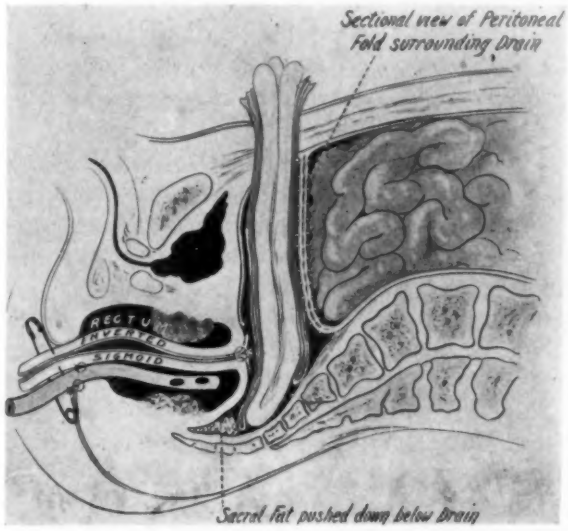

Fig. 11. Large quarantine drain placed in pelvis after first stage of operation for removal of cancer of rectum.[1]

we have described in "Principles of the Operation for Carcinoma of the Rectum."[1] We know of no one who has been successful with this type of operation for cancer of the rectum who has tried to substitute a small drain of any kind for the quarantine as shown in Figure 11.

15. We were never able to get uniform success in the operation of transplantation of the ureters until we adopted the quarantine of the lower pelvis which both kept the intestines from the infected area and permitted of retroperitoneal drainage. (Fig. 12.)

[1] *Surg., Gynec. & Obst.*, 38: 723, 1924.

The protected quarantine herein described, which was devised twenty-five years ago to meet the conditions arising

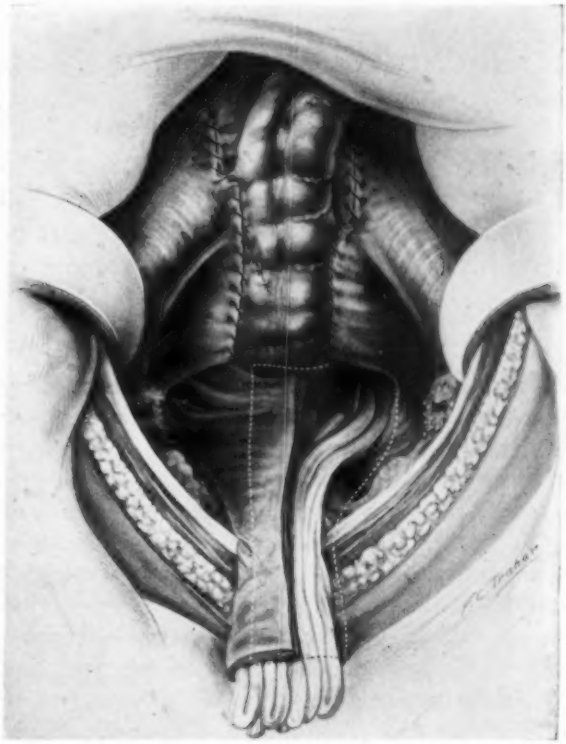

Fig. 12. Quarantine placed in operation for bilateral transplantation of ureters by tube technique.[1]

from diversified surgical conditions treated before the development of the modern hospital, has been constantly used during the intervening years in a great many and a great variety of cases. I believe it to be the most important principle which has entered into my surgical practice, both as regards the saving of lives and eliminating morbidity.

[1] *Surg., Gynec., & Obst.*, 47: 593, 1928.

THE GENERALIZED TYPE OF OSTEITIS FIBROSA CYSTICA

WITH A REPORT OF A CASE*

By William B. Coley, M.D., F.A.C.S., and Bradley L. Coley, M.D., F.A.C.S.

NEW YORK

INASMUCH as this condition, osteitis fibrosa cystica, generalized, is extremely rare, the following report of a recently observed case may prove of interest:

CASE REPORT

G. M., male, aged fifty years, a salesman by occupation, was admitted to the Hospital for Ruptured and Crippled on November 21, 1919 with the following history:

While on his way to the hospital to consult Dr. Virgil P. Gibney for a condition of weakness and pain in the legs which had persisted for seven or eight years, the automobile in which the patient was riding struck a truck and overturned, imprisoning him. He was released and helped to his feet; immediately complained of very severe pain in the back.

On admission to the hospital he was suffering intense pain and had difficulty in breathing. The pain in the back was aggravated by any motion.

The patient's past history is of interest: He was seen at the Neurological Hospital and at Mount Sinai Hospital in 1915, at which time he complained of weakness of the left leg and left arm. There was marked atrophy of the left hand and both legs. Both reflexes were present. Wassermann: negative. At that time a diagnosis of amyotrophic lateral sclerosis was made. He remained in Mount Sinai for three weeks and was then discharged. It should be noted that Dr. I. Strauss at that time made a diagnosis of multiple myeloma.

Shortly thereafter his teeth were extracted in the belief that the pain might be due to focal infection from the teeth. According to the patient his health had been perfect until the age of thirty-five, or fifteen years previously.

At the age of thirty-five he had an attack of "sciatic rheumatism" lasting one year during which time he was treated with iodide of potash. About seven years later he first felt weakness and pain in both legs with "sticking" pains in the soles of the feet which persisted for about two months. He remained free from pain until the following winter when it recurred with increased severity and lasted for another two months after which it disappeared until 1913, when it again recurred. Iodides were again prescribed but refused. During these attacks the patient had difficulty in going up and down stairs. He had had no gastric crises, no urinary symptoms and was able to find his way about in the dark without difficulty.

From 1913 to 1919 he was laid up every winter with these attacks of pain and disability. In the summer months he had no pain but suffered from weakness of the same degree as that experienced during the winter months.

The patient stated that the nodules which were present on the anterior surface of the tibia had been present for only two months. According to him, six Wassermann reactions were reported negative.

Physical examination on November 22, 1919, by Doctors Kleinberg and Sneed, showed the back to be symmetrical and the spine in the median line. There was no knuckling of the spine nor any disturbance of the anteroposterior physiological curve of the spine. There was no pain nor tenderness referable to the spine. There was some inconstant tenderness of the ribs on the right side in the axillary region, to which region patient referred most of his pain. The back and spine appeared normal in the standing posture. The motions of the spine were practically entirely restricted.

Roentgen-ray Examination. "The plates are hazy and it is not possible to make a definite diagnosis. There appears however to be some crushing and diminution of the size of the ninth and tenth dorsal, and first and second lumbar vertebrae. It is distinctly advisable to take another series of plates after the patient had been properly prepared by catharsis and enemata, to confirm or deny their findings.

*Submitted for publication April 2, 1929.

Although the rœntgen-ray appears to point to a crushing or fracture of the vertebrae, the patient lacks the general important clinical symptoms, namely, localized pain and tenderness in the spine. In view of the history of prolonged pain in his legs and the roentgen-ray findings of distinct bone disease, it is possible that he has had for some time a similar bone lesion in the spine."

Examination revealed an enlargement, the size of a hazelnut, at the junction of the upper and middle thirds of the right tibia. The left tibia exhibited an enlargement the size of a hen's egg on its anterior surface in the middle third. On the left, the patella reflexes were barely perceptible. The plantar reflexes were exaggerated especially on the left side.

Diagnosis. Syphilitic (gummatous) enlargement of both tibiae and possibly the left femur and rib.

Wassermann reaction, November 24, 1919 reported negative.

Blood count, January 16, 1920:

R.B.C.	4,720,000
W.B.C.	6,000
Hemoglobin	85 per cent
Red cells normal	
Polynuclears	56.0 per cent
Lymphocytes	35.0 per cent
Eosinophiles	3.5 per cent
Transitionals	2.5 per cent
Nucleated reds	none

Urinalysis December 8, 1919

Straw color	Neutral reaction
Slightly turbid	Sugar none
Scanty sediment	Albumin none

Specific gravity 1.011

No Bence Jones bodies; many granular casts.

Dr. Alfred Taylor saw the patient in consultation on November 24, 1919. He had lost much weight. His teeth showed considerable infection. There was no urine disturbance. Both lower extremities showed disturbance of knee jerks and ankle jerks. Both tibiae showed irregular bone enlargements. There was atrophy of both lower extremities and apparent weakness of muscle power. Roentgenograms were too indistinct to be satisfactory; however, they showed some apparent disturbance of the lower dorsal vertebrae. This combined with loss of strength and increased reflexes of the lower extremities suggested some disease of the vertebrae causing pressure on the anterior columns of the cord.

An operation was performed by Dr. Barrie on December 19, 1919: A vertical linear incision was made through the skin to the bone along the inner border of the left tibia at the junction of the middle and lower thirds. A wedge measuring 2½ inches by 1 inch was removed from the tibia and the contents scraped out. Owing to the very profuse hemorrhage which followed the curettage it was found necessary to pack the cavity very tightly and to leave the wound partially open.

Pathological Report (tissue removed from tibial cavity): "Giant-cell sarcoma. This tissue conforms with Dr. Barrie's hemorrhagic osteomyelitis."

Injections of the mixed toxins of erysipelas and Bacillus prodigiosus were given for several weeks. By January 5, 1920 the wound had healed. The patient was apparently benefitted by the treatment; and the disease showed little evidence of progress for a period of nearly five years.

In December, 1924 the patient appeared in Bellevue Hospital. At that time a section of the specimen removed in 1919 by Dr. Barrie, was sent to Dr. Symmers, Director of the Laboratories at Bellevue, who wrote as follows:

"The patient is now under observation in the First Medical Service of this institution under the care of Dr. Van Horn Norrie. He has multiple exquisitely painful bone tumors and, until your section arrived, we were all under the impression that the patient was suffering from multiple myelomata, although there was no Bence Jones protein in the urine. Examination of your section, however, seemed to show beyond doubt that the growths belong in the same category as that described by Barrie as hemorrhagic osteomyelitis and by Martland as multiple benign medullary tumors. The fact that the tumors are so painful, however, is a clinical argument against this diagnosis. Nevertheless, the microscopic examination would appear to set that doubt at rest."

The patient left Bellevue Hospital and was admitted to the Memorial Hospital on January 1, 1925. Physical examination at this time showed the left tibia occupied by a localized tumor the size of an egg on the anterior aspect. Several smaller nodules were found in this region. The right tibia showed the presence of a number of small nodules; both femora seemed thickened on palpation. There was a mass on the upper ribs of each side in the anterior maxil-

lary line. There was bony tenderness over most parts of the body except the skull.

Roentgen-ray report, January 7, 1925: "The

FIG. 1.

films reveal evidence of involvement of all the bones. *Diagnosis:* Von Recklinghaussen's disease or cystic osteitis fibrosa multiple."

Sections of Dr. Barrie's original operation were submitted to Dr. Ewing who reported as follows: "Osteitis fibrosa with giant-cell tumor. Many nuclei of large cells are very hyperchromatic."

Blood count taken January 4, 1925:

Hemoglobin	75 per cent
R.B.C.	3,600,000
W.B.C.	17,000
Polynuclears	80 per cent

Blood chemistry taken January 9, 1925:

Urea nitrogen 14 mg. per 100 c.c.
Blood sugar .136 per cent
Uric acid 4.5 mg. per 100 c.c.

Treatment at Memorial Hospital: Low-voltage roentgen-ray treatment over both legs and both arms; thyroid extract, grains ½, O.D.; cod liver oil, oz. ½, T.I.D.; calcium lactate, grains 15, T.I.D.

No marked benefit was observed and the patient was discharged from the Memorial Hospital in the latter part of January, 1925. He was readmitted to the Hospital for Ruptured and Crippled on May 26, 1925, with a history of having fallen to the floor on the day of admission. He was carried to bed suffering excruciating pain in both legs.

Physical examination revealed nothing not previously noted with the exception of pathologic fracture of the middle third of both femora.

FIG. 2.

On June 1, 1925, under ethylene anesthesia, a double plaster spica was applied from axilla to toes, by Dr. Bradley L. Coley.

Blood examination, July 13, 1925:

R.B.C.	3,970,000
W.B.C.	13,800
Polynuclear	88 per cent

The patient grew progressively weaker and died on July 15, 1925, After his death, some tissue was removed from the tumor of the tibia and examined microscopically by Dr. Ewing; this showed the same condition as was found at the exploratory operation performed six years previously, i.e., "giant-cell sarcoma."

The subject of osteitis fibrosa cystica has been so admirably and so exhaustively treated by Dr. John J. Morton,[1] former Assistant Professor of Surgery, Yale University School of Medicine, and now Professor of Surgery at the University of Rochester, that it is unnecessary to do little more than refer to his paper here.

[1] Morton, J. J. *Arch. Surg.*, 4: 1922.

According to Morton, the literature on this subject is very scarce, and aside from an article by Lötsch,[1] no extensive publication has been devoted to this type of the disease.

Fig. 3.

Morton gives a detailed description of his case illustrating it with photographs and roentgenograms. It is briefly as follows:

A man, aged twenty-three years, a lathe operator, came under the care of Dr. Morton on November 14, 1919, having been referred by Dr. Stanley Cox of Holyoke, Massachusetts. The chief complaint was bowing of the thigh bones. The patient's past history was negative except that three years previously, he had had an attack of erysipelas, lasting about three weeks; at the age of three years, he had fallen fracturing the right femur (good union) and at the age of four years, the right arm had been hit by a swing and broken just above the wrist.

He had no further trouble until he was twelve years of age, when he fell and was unable to walk for two or three days. At the age of sixteen, he fell over a railroad track and broke his right femur. He was laid up at the hospital for six weeks, the fracture uniting without complication. In March, 1919, he began to have pain above the right knee, and later on he felt some pain in the left knee. Physical examination in October, 1919, showed a marked outward bowing of both thighs, especially the right.

Fig. 4.

Roentgenograms were taken of practically all the bones in the body, and the following condition was noted: The periosteum of the cranial bones was of normal appearance; the cortical bone was not thickened; but scattered through its substance were clear spaces, especially marked in the frontal and occipital regions. These spaces varied from the size of a pinhead to a pea and were surrounded by a slightly denser shadow. The vertebral column showed nothing worthy of note. The clavicles, scapulae, ribs and iliac bones were normal. The right humerus showed at the junction of the upper and middle thirds unmistakable early evidence of the disease process. Here the corti-

[1] Lötsch. *Arch. f. klin. Chir.*, 107: 1–137, 1925.

cal bone presented a thinning and spongy cystic formation, with slight reaction about the clear spaces. The periosteum was unchanged, and

Fig. 5.

there was no deformity of the bone. With the exception of the ribs and clavicles, most of the skeletal bones were found to be involved.

On January 5, 1920, a wedge-shaped osteotomy was performed on the femur, and a second operation was done in October, 1920. The cortical bone was found to be fairly soft in consistence and vascular. The specimen removed at the first operation was examined by Dr. V. C. Jacobson, Pathologist of the Peter Bent Brigham Hospital, whose diagnosis was osteitis fibrosa.

Morton divides these cases into two main groups, the first being without giant-cell sarcoma, and the second, with giant-cell sarcoma. We believe that his case belongs in the first group, and our own in the second group; and we shall confine our remarks chiefly to the latter group. Group 2 Morton subdivides as follows:

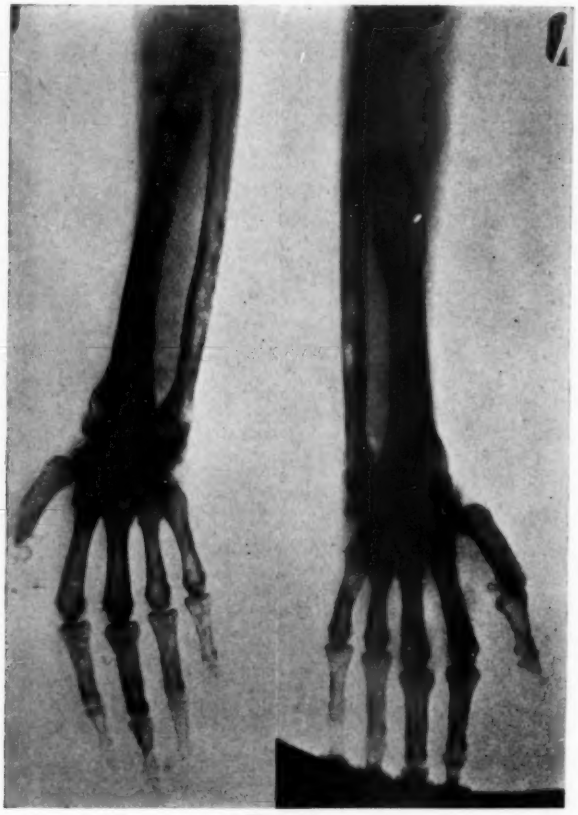

Fig. 6.

A. With cysts, fibrosis and giant-cell tumors, but no marked osteomalacia.

B1. With cysts, fibrosis and giant-cell tumors, and marked osteomalacia.

B2. With cysts, fibrosis, giant-cell tumors, osteomalacia and hyperostosis.

Morton was able to find only 17 cases associated with giant-cell sarcoma and osteomalacia. It is interesting to note that practically all of them proved fatal in the end, although death occurred at varying intervals, from two to twenty years. The condition is an extremely rare one and Morton states that not many cases have been reported; Barrie[1] was able to find but 4 in the American literature. One of these has been classed under Group 1 because of inadequate pathological data.

Apparently there is no definite age at which the disease is noted, Morton's

[1] Barrie. *Ann. Surg.* 71:581–593, 1920.

tabulated series showing the age to vary from nine to fifty years.

The chief symptoms are swelling, deformity, pain and fracture. According to Morton, there is no tendency to malignant change or to metastasis; but local recurrence is common unless operative removal is thorough. In subdivision A of Group 2, the prognosis is good and the disease is often cured by operation, although operation may have to be repeated for local recurrence. Morton found only 6 cases of this type in his collection.

In commenting on the pathology of the disease, Morton states as follows: "Von Recklinghaussen,[1] in his earliest description, regarded the disease as an inflammatory process, a chronic productive inflammation whereby fibrous tissue was substituted for bone structure, resembling in this way fibrous myocarditis or liver cirrhosis. In his later work he changed his belief and thought that he was dealing with a metaplasia of existing tissue and calcium withdrawal. Whichever view is correct the pathologic picture is fairly constant . . . The cysts always lie in the middle of the fibrous marrow at first and their walls are formed of thick fibrillae of this tissue, having a concentric arrangement and bound together by short strands. True epithelial or endothelial linings are lacking; but in spite of this the cavity walls are fairly smooth. The contents are usually fluid—thin or gelatinous, water clear, yellow or reddish according to the amount of blood extravasation. The changes noted occur in the beginning in circumscribed patches in individual bones. The whole bone becomes involved later by broadening out and confluence of the pathologically changed places. The epiphysisand periosteum, as a rule, remain unchanged. The metaphysis in young bone and the diaphysis in formed bone seem to be the places of predilection. The formation of the giant-cell tumors may or may not be extensive. In all cases, giant cells are present, but in one group in not sufficient numbers to form the masses of brown red tissue which

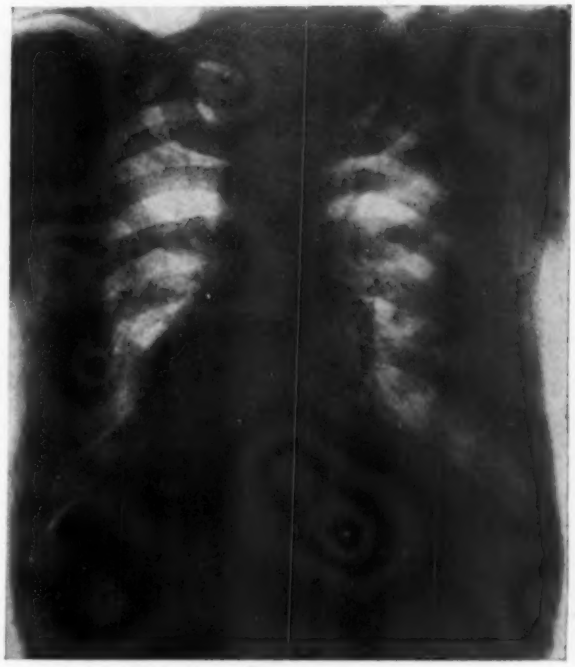

Fig. 7.

has received so many names and caused so much controversy as to its nature."

Morton believes there is now abundant pathological and clinical evidence at hand to establish firmly the benign nature of these giant-cell growths. They grow locally only, do not metastasize, recur only on incomplete removal, and may be removed by local operation several times is necessary. While the multiplicity of the tumors does not signify metastasis in the sense of an ordinary malignant neoplasm, it is hardly fair to classify these cases as benign inasmuch as in every one of them reported, the disease proved fatal within two to twenty years from the time of first observation.

There is practically nothing known about the cause of the disease. Personally we believe it to be of an infectious nature due to an unknown causative agent, a microorganism of some kind.

In regard to the differential diagnosis, this condition differs from the ordinary sarcoma in the multiplicity of the lesions,

[1] von Recklinghausen. Rudolf Virchow, 1891. Festschr. Untersuchungen uber Rachitis and Osteomalacia. 1910.

the slow progress of the disease, the tendency to multiple fractures and the roentgenographic appearances of the bone. marrow space, and the replacement of the cortical bone and its lack of definition from the marrow cavity constitute a

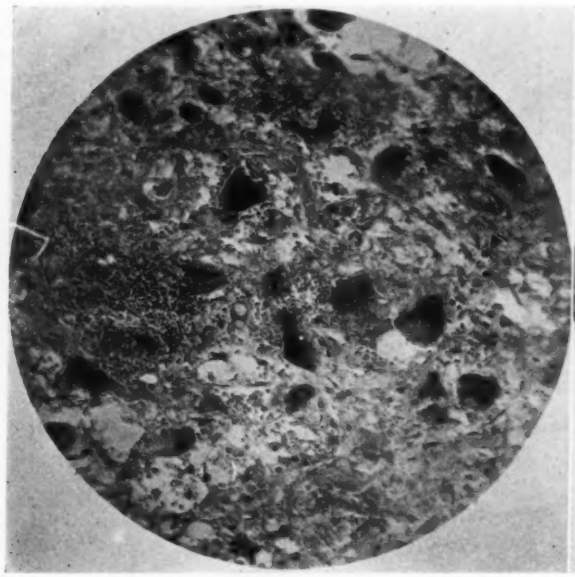

FIG. 8.

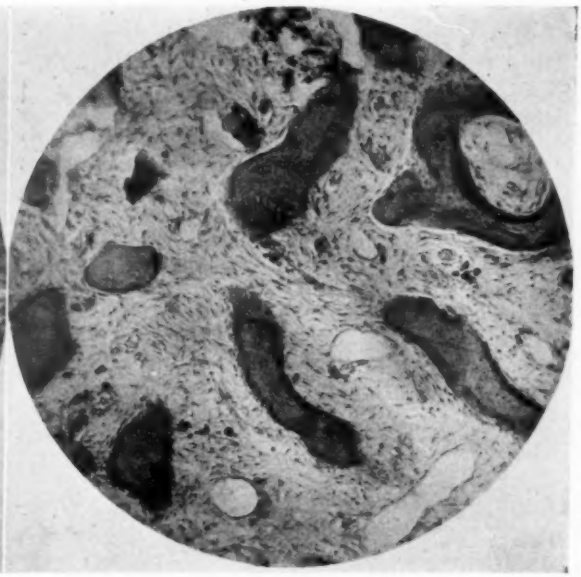

FIG. 9.

It can be differentiated from the ordinary osteomalacia from the fact that the symptoms are more severe and the deformities more pronounced. The roentgenographic appearances are fairly characteristic. The periosteum is not involved but remains smooth and normal in outline except at the site of a fracture. The process rarely involves the epiphyses or joints. Roentgen-ray examination of the bone marrow shows a widening of the marrow cavities and an irregularity in outline. The cortex often has a mottled appearance. As Morton so well describes it in his paper: "It is impossible at times to tell where the cortex leaves off and the marrow cavity begins, the process becomes so confluent. The whole bone picture is also striking because of the washed-out calcium content which gives a general translucence, and a honeycombed picture where cystic changes have occurred. Occasionally, cystic cavities show fine septal bridges making compartments, which some of the French observers compare to the cut surface of a tomato. Taken as a whole, the translucence of the bone, the irregular, rarefied patches and long porous streaks, the enlargement of the picture not liable to be mistaken for any other condition. The bony deformities are marked, and the bones are angulated where fractures have occurred so that a smooth curve is not the usual finding. The bones show expansion and reinforcement on the concavity of the cortex, but the latter never of marked density."

Thus far, no method of treatment has been found that has any marked effect upon the progress of the disease. The treatment is purely symptomatic, treating the fractures as they occur and occasionally operating for correction of the deformities.

In regard to the prognosis, Morton states that those cases not associated with general malacia with or without giant-cell tumors, have the most favorable outlook; whereas in the other group in which there is a combination of general malacia with giant-cell tumors, the disease is practically always fatal.

In our own case it is not improbable that the course of treatment with the toxins of erysipelas and B. prodigiosus six years ago had an inhibitory action on the disease and prolonged the life of the patient, although, it is impossible to be sure of this.

REACTION TO IODINE

OF GOITERS FROM A GOITER AREA*

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ANN ARBOR, MICH.

A STUDY of the recent literature on the reaction of goiter to iodine shows striking differences of opinion concerning the theory of its action and also as to facts of observation. Some of the differences of observation may possibly be explained by variations of environment and for purposes of comparison a study of the reaction of iodine and goiter in Michigan has been made. Michigan lies in the Great Lakes goiter belt and has had careful goiter surveys made by the Michigan State Health Department. It was shown that the iodine content of the water varied from a mere trace in the region adjacent to Lake Superior to 880 parts to 100 billion in the southern part of the state. The incidence of goiter was inversely proportional to the amount of iodine in the drinking water. Since 1924 an iodine salt containing 1 part of sodium iodide to 5000 parts of table salt has been sold throughout the state and its use varies in different communities from 50 per cent to 95 per cent of all the table salt. It is estimated that each adult using this salt gets about 400 mg. of iodine per year.

For purposes of study a group of patients with hyperthyroidism treated by operation during a period in 1928 was selected. These were divided into two groups according to the pathological findings in the goiter, exophthalmic goiter and adenomatous goiter. All goiters with mixed findings, that is otherwise typical exophthalmic goiter but with adenomas, were excluded. All case histories were then gone over and any case not seeming to fall clearly into our clinical conception of these two types was excluded. All patients were questioned about the use of iodine and any having had recent iodine medication were also excluded from consideration. As a result of this selection, 128 cases of exophthalmic goiter and 50 cases of adenomatous goiter with hyperthyroidism were chosen, this representing the clinic ratio of these groups. All patients were given the same amount of iodine daily, as 1 c.c. of compound solution of iodine (Lugol's solution), this dosage being the one used by other clinics with which we wished to establish a comparison. We wished to determine:

1. A comparison of the reaction of exophthalmic goiter to that in a non-goiter area.

2. A comparison of the reaction of exophthalmic goiter and of the adenomatous goiter.

3. Facts regarding the reaction of the adenomatous goiters.

1. REACTION OF EXOPHTHALMIC GOITER

The general facts regarding the favorable influence of iodine on the preoperative and postoperative course of this disease are well established and our experience is in perfect accord. The effect of the iodine response was measured in terms of basal metabolism, while the clinical improvement and histological changes were typical of those described by many observers. An endeavor was made to have at least two or more pre-iodine metabolic rates but this was impossible in certain sick patients in whom the early use of iodine was a necessity and in these patients only a single pre-iodine metabolic rate was obtained. As a consequence the study is not absolutely accurate but since all data were collected under about the same conditions, we feel that it represents a fair

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estimate of the reaction of exopthalmic goiter in the clinic to iodine. The data are shown in Figure 1. For purposes of comparison we chose the report of Means et al.[1] of a study of the iodine reaction in 128 cases of exophthalmic goiter from Massachusetts, a non-goiterous area on the seacoast. A comparison of the drop in the basal rate in the two series is shown graphically in Figure 1. In our series as in his the declivity of the curves is in general related to the initial height; the greater the initial basal metabolic rate, the sharper the drop.

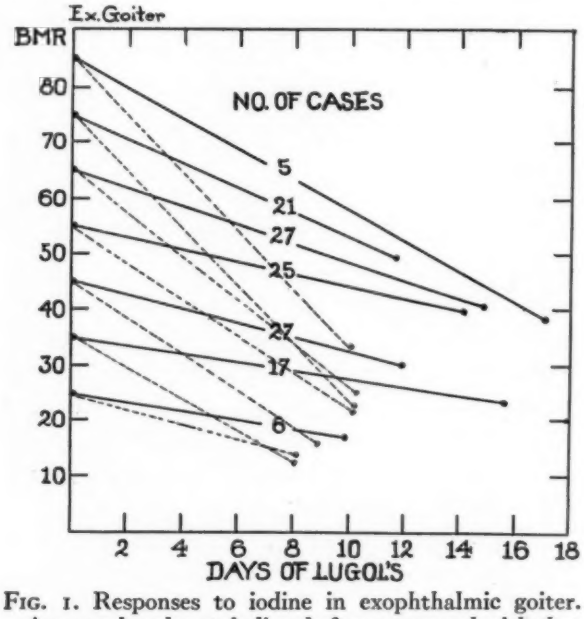

Fig. 1. Responses to iodine in exophthalmic goiter. Average basal metabolism before compared with that after iodine is used. Abscissae represent average time required for response. 128 cases divided into groups according to pre-iodine metabolic rates, each 10 point rise defining a group. Solid lines represent Michigan series. Dotted lines copied from Means' study of a similar number of cases. Number of cases refers to our group.

Table 1

Tabular comparison of reactions of two series of exophthalmic goiter to iodine, showing greater response in Means' series

Group by B.M.R.	B.M.R. Following Iodine				Difference
	Means Series	Days	Present Series	Days	
80–90%	34+	10	38+	17	4
70–80	24+	10	48+	12	24
60–70	26+	10	40+	14	14
50–60	24+	10	39+	14	15
40–50	18+	9	30+	12	12
30–40	15+	8	23+	16	8
20–30	17+	8	17+	10	0

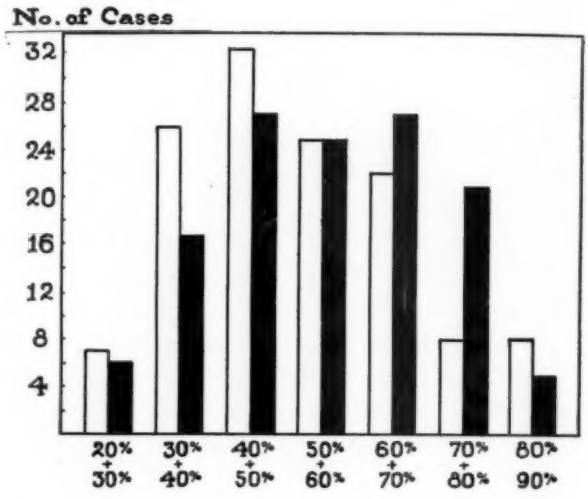

Fig. 2. Comparison of severity of cases in each series showing number of cases in each 10 point division of pre-iodine basal metabolism. Michigan series black, Means series unshaded.

There are two main differences noted. First, a longer period of time is necessary in our series to reach a base line and, second, the fall in basal metabolic rate is not as great. This is shown in Table 1, in which one can see that the fall of basal metabolic rate in Means' series is greater in all except the lowest group, the others dropping from an average of 4 to 24 points more than corresponding groups in our series.

Since the total number of cases in the two series is the same, a comparison between the severity of the cases can be made and this is shown in Figure 2. There is a slight preponderance in our series in the groups with a high basal metabolic rate. In the total number of our series 14, or 11.7 per cent, were refractory and did not react favorably to iodine in that there was no change in the basal metabolic rates after the ingestion of the amounts of iodine given to the others. These were not given larger amounts of iodine but were treated by operation without the occurrence of thyroid crises which was thought to be due to the iodine although it did not cause any marked preoperative drop in

basal metabolic rate. The occurrence of these cases in any group causes a flattening of the declivity and lengthening of the

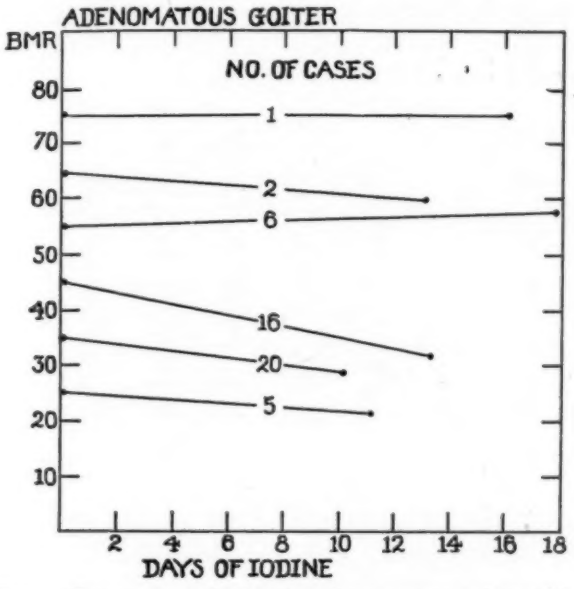

Fig. 3. Response to iodine in adenomatous goiter with hyperthyroidism. Average basal metabolism before compared with that after iodine is used. 50 cases divided into groups according to pre-iodine basal metabolism rates, each 10 point rise defining a group.

curve and may partially account for these differences in the two series.

From these observations we can state that our series of cases of exophthalmic goiter reacts less actively and arrives at a base line more slowly than a series of similar cases from a non-goitrous area. It may be thought that the use of an iodized table salt has produced an iodine refractory state in the goiters from this area but it is our impression that this same condition existed in the year prior to the adoption of the general use of the iodized salt when iodine was used in the preoperative treatment of goiter. Unfortunately such a comparison of the iodine reaction before and after the use of iodized salt cannot be made on any worth while scale since frequent basal metabolic determinations were not made in our clinic during that time. It is not a matter of great practical importance to the patient since the use of iodine causes enough improvement to make operation safe and abolishes postoperative crises.

All of the cases in this group were operated upon without mortality and very few were operated upon by fractional

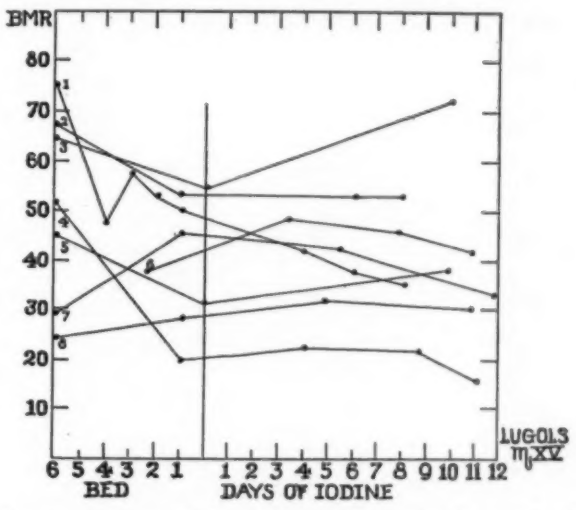

Fig. 4. Curves of basal metabolic rates in cases of adenomatous goiter with hyperthyroidism (1–8 incl.). Dots show basal metabolic determinations. Vertical line marks beginning of iodine.

methods. In none was ligation done and in 10 cases hemithyroidectomies were done at intervals.

II. Reaction of Adenomatous Goiter with Hyperthyroidism (Toxic Adenoma)

This group of 50 cases entered the hospital during the same period of time as did the group of exophthalmic goiters. As stated they include only cases having all the pathological and clinical attributes of the typical adenomatous goiter. Many of them had the common cardiac complications of this disease. All of them were given rest in bed from seven to forty days before iodine was given. In most instances several basal metabolic rates were taken before and after the administration of iodine. The cases vary greatly in the duration of their hospital stay due to differences in severity of disease, and to sociological and financial considerations. In determining the effect of iodine we have estimated as closely as possible the average basal metabolic rate after bed rest, to compare with the rate after the administration of iodine. The length of time of

iodine administration varied greatly in that we were obliged to operate upon those patients earlier who were in fit condition

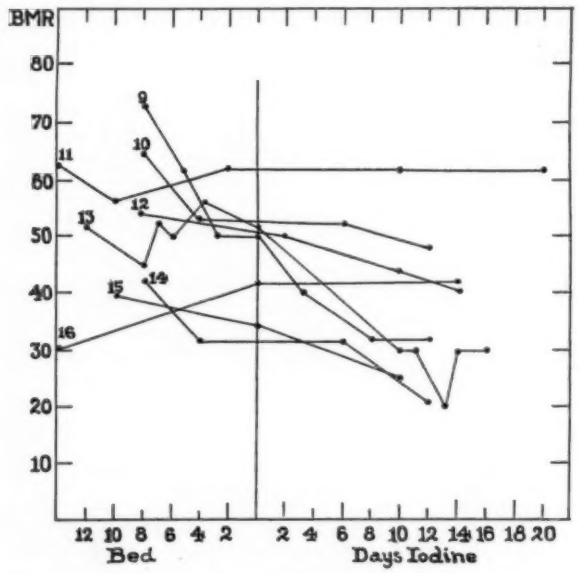

FIG. 5. Curves of basal metabolic rates in cases of adenomatous goiter with hyperthyroidism (9–16 incl.); 9 and 13 show very favorable response.

for it and keep for longer periods of time those who had cardiac or other complications. While the study is open to criticism in that perfectly even levels were not reached either before or after the use of iodine, it offers a fair comparison with the group of exophthalmic goiters which was treated under similar conditions.

TABLE II

COMPARISON OF FALL IN BASAL METABOLISM WITH IODINE IN 128 CASES OF EXOPHTHALMIC GOITER AND 50 CASES OF ADENOMATOUS GOITER. SHOWING GREATER FALL IN EXOPHTHALMIC GOITER IN ALL EXCEPT ONE GROUP

Groups by B.M.R.	Fall of B.M.R. with Iodine				Difference
	Ex. Goiter	Days	Ad. Goiter	Days	
70–80	27	17	0	16	27
60–70	25	15	5	12	20
50–60	15	14	+3	18	18
40–50	14	12	14	14	0
30–40	12	16	6	10	6
20–30	10	10	3	11	7

The average reactions of this group to iodine are shown in Figure 3 for comparison with Figure 1. The declivity of all the curves is less than in the exophthalmic goiter group and do not show the uniform

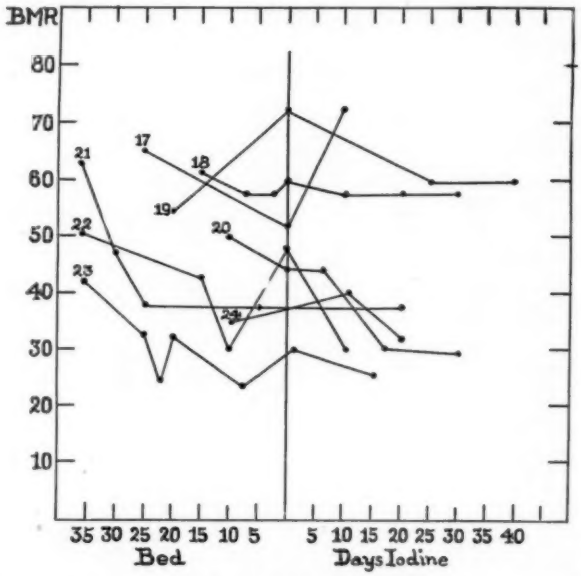

FIG. 6. Curves of basal metabolic rates in cases of adenomatous goiter with hyperthyroidism (17–24 incl.). This group were under observation longer periods of time. 17 shows unfavorable response.

downward trend. In one group there is actually an appreciable upward curve. In Table II is shown the average figures of these two groups, showing the fall in basal metabolic rate with the adenomas is much less in all except one group. Of all adenomas 23, or 46 per cent, were not affected favorably by iodine, contrasting with the 11.7 per cent of the exophthalmic goiters with the same lack of reaction. This factor was chiefly operative in flattening the declivity of the curve in the adenoma group.

III. OBSERVATIONS ON THE ADENOMAS

In Figures 4 to 7 are shown the actual curves before and after the use of iodine in 32 adenomas chosen as representative members of this group with varying periods of rest in bed and of days of iodine use. The striking fact about these reactions in general is the lack of uniformity of type. The initial metabolism is usually much higher than subsequent determinations showing the fallacy of regarding solitary observations as of great importance. A

remarkable improvement is noted with rest alone in many cases but several patients had a rise in rate after rest in bed. Sturgis[2] has pointed out that it takes several weeks of rest and familiarity with the test to arrive at a stabilized basal metabolic rate in cases of exophthalmic goiter and there may be fluctuations of metabolism of as much as 23 per cent from day to day. These facts make one doubt the absolute accuracy of any series of observations made over short periods of time and make their value only relative. A number of cases reacted brilliantly to iodine and interestingly enough only 4 cases were actually made worse by iodine. In several cases iodine was given from thirty to forty days without production of any iodine hyperthyroidism either in cases with original improvement from its use or in those that had remained unimproved by its use. Other cases remain perfectly unchanged by iodine. One must conclude from these observations that one cannot prophecy what the effect of iodine is going to be in any given case of adenomatous goiter with hyperthyroidism since it may vary from striking improvement, to no action, to marked increase in symptoms. Rest in bed alone causes a great improvement in many cases but may have no effect on others.

COMMENT

There is a difference of opinion as to whether adenomatous goiter with hyperthyroidism and exophthalmic goiter are two separate diseases. It has been commonly believed that while iodine has a beneficial effect on exophthalmic goiter it has a harmful effect on adenomas. Those who believe that fundamentally the diseases are one have attempted to show a similarity of response to iodine in the two conditions. Those who believe them to be separate entities state that iodine given to adenomas will cause iodine hyperthyroidism and increase the severity of the disease. There are two commonly accepted theories as to the mode of action of iodine, that of Plummer[3] in which exophthalmic goiter is regarded as a dysthyroidism that is converted to a pure hyperthyroidism

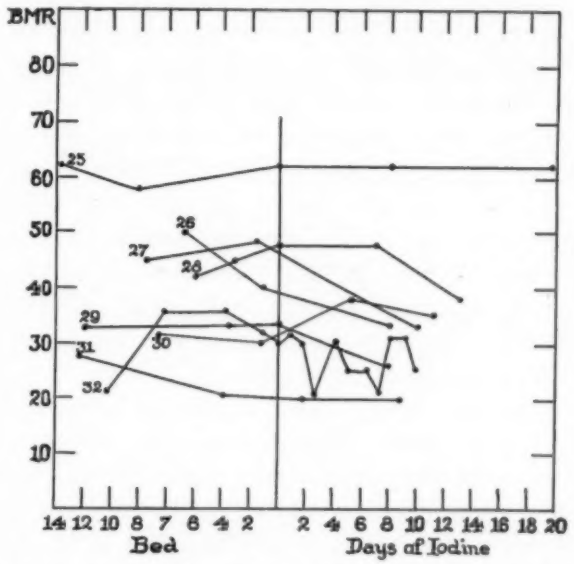

Fig. 7. Curves of basal metabolic rates in cases of adenomatous goiter with hyperthyroidism (25–32 incl.).

by the use of iodine, and that of Marine[4] who regards the rapid distention of the alveoli with colloid as causing a pressure retention with temporary blocking of excretion which is soon compensated for, with a return of symptoms. It has been asserted that differences in reaction of exophthalmic goiter and adenomatous goiter to iodine prove them separate disease entities and it has also been asserted that similarities of reaction prove them identical disease entities. Certainly the distinction between or similar identity of those conditions need not rest on these reactions to iodine. Without entering the controversy, which is of only academic interest, if one regards them as the same disease they are markedly different phases of it, with pathological changes in the adenomas that have taken years to form and in the exophthalmic goiter that may occur in a few weeks.

On the basis of our findings we are unable to agree with those who assert them to be identical because of similar reactions to iodine. There is a uniformity of reaction in the exophthalmic goiter

that is lacking in the adenomas. The adenomas may react as favorably as exophthalmic goiter but many react unfavorably and others not at all, and no one can foretell what the reaction will be. It is possible that larger amounts of iodine might have altered the type of reaction but for this study we felt it necessary to use a constant amount in all cases. They may be related clinical entities but their reactions to iodine do not seem parallel enough to warrant this assumption on this point alone. Longer and more careful studies of these reactions are necessary before we may be dogmatic.

On the other hand we have observed but few cases of adenomas in which it appeared that harm was done by the use of iodine even if taken over periods of thirty to forty days and we feel that the dangers of inducing iodine hyperthyroidism or of increasing the severity of the disease are not great with patients under observation. That iodine hyperthyroidism does occur there can be no doubt since such cases are seen not infrequently, usually due to the unwise use of Lugol's solution, and we feel that iodine has no part in the non-operative treatment of adenomas but used as a preparation for operation it may be of great benefit and will not do harm if the patients are closely watched.

Since the introduction of iodized salt we have watched for evidence of iodine hyperthyroidism that could be ascribed to a use of the product and while an occasional patient is seen who believes such to be the case we have not been convinced that we have seen a single instance of hyperthyroidism due to the use of iodized table salt. This statement is of interest because of the rather widespread criticism of this method of giving iodine, on theoretical grounds by those not familiar with the actual results in the state.

Another reason for use of iodine in all cases of hyperthyroidism is that it is impossible at times to differentiate with assurance between the various kinds of goiter and if one withholds iodine from exophthalmic goiter or the mixed types in the belief that it is an adenomatous goiter there may occur distressing postoperative complications. When one is familiar with the wide range of pathological pictures that may occur in adenomas varying from acini capable of involution to histologically formless masses of calcification or cysts it is not strange that there occur variations in physiological response to iodine. Marine[5] has shown that certain adenomata would involute with iodine but that others had lost this power. It was not possible to tell from histological examination which adenomata would and which would not react to iodine. It seems logical to account for the difference in reaction of these goiters to iodine by the differences in the pathological condition in the gland, rather than assume that we are dealing with a variety of diseases. We believe that iodine should be used as a preoperative measure in all cases of adenomatous goiter with hyperthyroidism as well as in exophthalmic goiter, if the cases are carefully watched for the occasional untoward reaction. We do not find enough similarity of reaction to iodine between the adenomatous goiter with hyperthyroidism and exophthalmic goiter to warrant the assumption that they are the same disease even though such may be the case.

CONCLUSIONS

1. A comparison of the reaction to iodine of exophthalmic goiter from a goiter area and a non-goiter area shows that, in general, cases from the goiter area do not improve as much and react more slowly.

2. In 11.7 per cent of cases of exophthalmic goiters no drop in basal metabolic rate occurred with iodine.

3. Adenomatous goiters with hyperthyroidism do not react to similar amounts of iodine in a manner enough like exophthalmic goiter to warrant the assumption on this ground alone that they are the same disease.

4. In 46 per cent of the adenomatous goiters with hyperthyroidism a favorable reaction was not obtained.

5. One cannot prophecy what the reaction in adenomatous goiters will be since it varies between brilliant improvement, to positive harm.

6. The use of iodine as a preoperative measure in all cases of adenomatous goiter with hyperthyroidism and of exophthalmic goiter is advocated.

7. The danger of inducing iodine hyperthyroidism in adenomatous goiter by preoperative iodine medication is small.

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THE INTERDEPENDENCE OF THE THYROID, ADRENALS & NERVOUS SYSTEM*

G. W. CRILE, M.D., F.A.C.S.

CLEVELAND

THE nervous system may properly be considered as including not only those organisms and structures generally included in the central and vegetative nervous systems but also the adrenal and the thyroid glands, since the latter together with the former control the adaptive energy-transformation of animals. Adaptive energy-transformation is the one outstanding factor that distinguishes the animal from the plant. An animal may be regarded, therefore, as a higher plant to the equipment of which has been added a mechanism for adaptive energy-transformation, that is, the transformation of potential into kinetic energy. I still think this system may not illogically be designated as a "kinetic system."

The most outstanding and unique example of a continued activation of this group of organs which results in continued increase in energy-transformation is a state of hyperthyroidism.

In hyperthyroidism not only is there a continued increase of energy-transformation but from time to time there appear crises during which the transformation of energy is temporarily increased still further. In a thyroid crisis the organism is driven so intensively and its functions are so magnified that the crisis serves as a physiologic microscope through which are revealed more clearly certain functions of certain organs. I propose to discuss the nature of these thyroid crises and their exciting causes, the mechanism that produces them, their peculiar setting, and the factors that govern them, and to offer evidence in support of the conception that hyperthyroidism is not primarily a disease of the thyroid gland but is rather a disorder of the entire kinetic system as defined above.

The clinical analysis of thyroid crises shows that they can be precipitated by any one of only eight factors, six of which are intraorganic, that is, originate within the organism itself, while two may be applied artificially. The six intraorganic factors are: (1) emotional excitation, such as fear, anger, worry, etc.; (2) foreign and split proteins, such as infection, wound secretion, etc.; (3) asphyxia; (4) hemorrhage; (5) pain; (6) physical exertion. The two artificially produced factors are: (1) the induction of inhalation anesthesia, and (2) the injection of adrenalin.

Whether the crisis be precipitated by a single one or by several of these factors, or whether the crisis occur merely in the natural course of the disease, the symptoms, and in fatal cases the mode of death, are identical. There must be, therefore, some common factor which is activated by these divergent exciting conditions. What common factor in asphyxia, hemorrhage, physical injury, physical exertion, emotional strain, infection, is responsible for the thyroid crisis? Exclusive of the injection of adrenalin, each of the factors enumerated above produces an increased output of the specific hormone of the adrenal glands, as has been proved by researches by Cannon and others as well as by ourselves, researches which have shown that the adrenals are activated by every activation of the central nervous system.

Moreover, it is significant that no other natural factor such as rest, sleep, food and water, heat or cold, and no drug such as

* Read at the Annual Meeting of the American Association for the Study of Goiter, Dayton, March 25–27, 1929.

sedatives, narcotics, digitalis, strophanthin, atropine, sodium bicarbonate and glucose, cathartics, calcium or magnesium, can produce a thyroid crisis. Even the administration of iodine or of thyroid extract cannot produce a thyroid crisis.' Moreover, in the absence of the thyroid gland, or when after thyroidectomy hyperthyroidism has been replaced by myxedema, each of these specific excitants loses its effect. In the absence of the thyroid gland or in myxedema the injection of adrenalin also loses its specific effect. Under such conditions a thyroid crisis cannot be produced even though any of these factors may be sufficiently potent to destroy the organism and produce death.

The symptoms of hyperthyroidism and of the crises of hyperthyroidism are identical with the symptoms of hyperadrenalism —dilated pupils, flushed skin, sweating, increased metabolism, increased action of the heart. The injection of adrenalin of itself alone produces these symptoms, and each of these symptoms is present in hyperthyroidism; the injection of adrenalin in the presence of hyperthyroidism causes an increase in every one of these symptoms. These symptoms in themselves betray the intermediary between the adrenals and the thyroid gland. The adrenals act through the nervous system upon the thyroid gland; the thyroid gland acts through the nervous system upon the adrenals; each of these three depends upon the other two. It is for that reason that we consider the ductless glands as inherent parts of the nervous system itself.

Further evidence that neither the nervous system, the adrenals, nor the thyroid gland can be considered alone is found in the following facts: (1) Hyperthyroidism has never been seen in a case of Addison's disease; (2) the excision of one adrenal gland temporarily lessens the symptoms of hyperthyroidism to a degree comparable to the removal of one lobe of the thyroid gland; (3) in myxedema, adrenalin loses most of its physiologic effect; (4) deep narcotization with morphine nullifies the effect of adrenalin; (5) no case of hyperthyroidism has been observed in a cretin or in the presence of a normal thyroid gland; (6) the division of the innervation of the thyroid gland controls the disease to a great extent; (7) physiologic rest profoundly benefits a patient with hyperthyroidism; (8) excitation of the nervous system is the most potent cause of the disease and of the crises of the disease. Finally, each of the six specific agents enumerated above as factors in the causation of a crisis of hyperthyroidism are also common exciting causes of the disease. These six factors produce their protean effects primarily by activating the nervous system, which in turn activates the thyroid gland and the adrenals. One might as well try to separate the nucleus and the cytoplasm of a cell, or the negative and positive plates of a battery, and expect either to operate alone as to expect the adaptive transformation of energy to continue in the absence of the nervous system, the adrenals, or the thyroid gland, each of which is an essential part of the organic machine.

It would seem more profitable to identify and study the energy-transforming system as a whole, and to find some new designation for the disease, rather than to relate it to a single organ which does not originate the disease but only collaborates in its origin and in its continuation.

The outstanding characteristic of hyperthyroidism is the facilitation and acceleration of the production and discharge of potential energy through the collaboration of a definite group of organs. As the result of this acceleration the energy-transforming system is speeded up, and for this reason I believe that a better term than hyperthyroidism to apply to the disease would be "hyperkineticism." By proposing this name we do not assume that we are in possession of all the factors involved in this protean disease but simply suggest that it would seem more descriptive than our present term.

Let me now offer certain experimental evidence as to the interrelation of the nervous system, the adrenals, and the thyroid gland:

Years ago we found that the administration of iodine or of thyroid extract produced an early hyperchromatism of the brain cells followed by progressive chromatolysis. The administration of a single dose of adrenalin produced hyperchromatism of the brain cells; the repeated administration of adrenalin was followed by chromatolysis of the brain cells. Significant as these findings were, they have become increasingly so as the result of investigations now being made in the laboratories of the Cleveland Clinic by Dr. Beutner, who has found that the stainability of cells is apparently a direct indication of their electromotive force or potential. Dr. Beutner is investigating this point by the construction of certain artificial systems consisting of organic substances, which react to different stains in the same way as did the hyperchromatic and hypochromatic brain cells in our experiments, and produce an electromotive force which varies with the stainability as we have found the electromotive force of a tissue to vary with its stainability.

Since iodine is the essential content of the product of the thyroid gland, and in view of the specific effect of this product on metabolism, we would suspect that it governs the electric permeability of the cells of the body. In our researches we have found that after a latent period of twelve or more hours, iodine and thyroid extract each in creases the electric conductivity and capacity of the organs and tissues of the body, in particular of the brain. In physical terms the change in the conductivity and capacity of a tissue signifies a change in the activity of that tissue. These physical changes, like the clinical changes due to thyroid activity, are lasting and not fleeting. Increased conductivity and increased capacity are associated with increased functional activity. These changes alone would increase oxidation and hence would increase basal metabolism.

These findings are comparable to those in similar physical measurements of plants, of growing tumors, of fertilized ova, of the ameba, etc. The argument may be advanced that what we have measured is a change in the concentration of the electrolytes in the tissues and cells or changes in blood supply. It is true that the changes in conductivity and capacity which we have measured are in part due to changes in electrolytic concentration, but changes in electrolytic concentration constitute an essential part of the mechanism of stimulation and appear coincidentally with changes in the permeability of the cell membranes. Moreover, in our experiments changes in conductivity and capacity have been found in tissues after death, when such changes must be independent of the circulation. These electrical changes run parallel with the clinical phenomena.

Our experiments have shown that the effect of adrenalin on the capacity and conductivity of tissues and organs is wholly different from the effect of thyroid extract and of iodine; that is, while the effects of thyroid extract and of iodine are not manifested until after a latent period of considerable length, adrenalin causes an immediate and a striking change in capacity, temperature and conductivity. Moreover, the effects of adrenalin last for only a few minutes while the effects of thyroid extract and of iodine last for hours and days.

The most striking characteristic of the adrenalin effect, however, is its unexpected selective action on the organs and tissues of the body; that is, adrenalin causes a sharp rise in the conductivity, temperature and capacity of the nervous tissue, but shows the opposite effect on the conductivity, temperature and capacity of all other tissues, with one notable exception, namely, the medulla of the adrenal gland itself. At first this highly selective action of adrenalin on the tissues and organs seemed incomprehensible until it occurred to us that differences in the potential of the organs of the body might well depend on this very effect.

We would expect that iodine and thyroid extract would raise the potential of the cells, and experiments performed in our laboratory have proved this to be the case. If iodine or thyroid extract increases the capacity of the cells and also the electric load of the cells, then we would expect that the adrenals and the nervous system would discharge the cells, would diminish their potential; and our experiments have indicated that this is the case.

As a result of our experiments it would appear that the organism has been evolved on the principle of electric control, and that it is the function of the adrenal glands and of the vegetative nervous system to establish and to maintain and adaptively to change the differences in potential among the different organs and tissues, in order to meet the conditions of struggle and survival, such as fighting or escaping, mating and procreating, combatting infection, etc. If this conception be true, then not only is there a collaboration between the adrenals and the thyroid but there is a collaboration among all the organs and tissues which are concerned not only with the struggle of life but with the maintenance of life itself. In accordance with this conception, if we were to measure the difference in potential between various organs and a neutral tissue such as fascia, we would expect to find that during life and consciousness a certain difference exists and that at death this difference is cancelled. We would expect to find that adrenalin would specifically alter differences in potential in the normal animal and that in myxedema it would exert but little effect on the difference in potential. We would expect that alterations in potential would be related to the physiologic activity of the various organs; and that the activity of the organs would be related to the thyroid hormone, which controls the conductivity for the longer periods, and to adrenalin, which controls the conductivity for shorter periods. These theoretical assumptions have been proved to be facts by the experiments performed in our laboratory by Dr. Telkes and Miss Rowland.

We may assume that the thyroid hormone by increasing the permeability increases the activity of the cells and organs, of the brain, in particular. Increased permeability would make more effective every kind of stimulation. This would be one of the essential factors of nervousness, perhaps the mechanism by which it is produced.

In myxedema, on the other hand, the conductivity, capacity and potential are decreased far below the normal level; and in consequence, the permeability, hence the facility of stimulation, is decreased proportionately. This would explain the decreased metabolism, the depressed facility for stimulation and the decreased bodily activities: dullness and lethargy, in clinical cases of myxedema. And as a climax to these observations we have found that when an animal is in myxedema, adrenalin has lost its striking control over the conductivity, capacity and potential, a finding which parallels the clinical observation of the lack of effect when adrenalin is injected into myxedematous patients.

Moreover, and of peculiar significance, has been our discovery of a specific reaction of the medulla of the adrenal gland itself to the injection of adrenalin. We have found that the injection of adrenalin into the vein of the ear of a rabbit causes a sharp rise in the conductivity and the capacity of the medulla of the adrenal, this effect being as striking as the effect of adrenalin on the brain, and in the same direction. It would appear from this finding that the medulla of the adrenals functions as nerve tissue; perhaps it is the brain of the vegetative system, its probable function being to charge up, that is, to energize the vegetative system. The embryologic origin of the medulla, the type of its cells and the kind of tumors that arise in it, all point to the same conclusion.

In his illuminating work on the adrenal gland and his interpretation of its function

along the lines of evolution, which was referred to in my Ether Day address, Cannon surely took an important step in the direction of this conception.

If we are correct in our belief based upon clinical and experimental investigations that the single agent which causes the acute exacerbations of hyperthyroidism is the adrenal, then it would follow that by the removal of one adrenal gland in cases of hyperthyroidism the factor of safety of the patient should be increased; that is, the removal of one adrenal, like the removal of one-half of the thyroid gland, should reduce the phenomena of hyperthyroidism. The objection may at once be raised that the factor of safety of the adrenal tissue is so great that the removal of one adrenal would show no effect. In normal cases this would be true, but in hyperthyroidism the factor of safety of the adrenal, like that of the thyroid, has been fully exhausted by excessive action and one would expect, in accordance with our conception at least, that by the removal of one adrenal, as by the removal of half of the thyroid gland, the phenomena of hyperthyroidism would be correspondingly reduced.

We have removed one adrenal gland in 10 cases of hyperthyroidism, and in those 10 cases the immediate clinical results were comparable to those which follow the removal of one lobe of the thyroid gland. The pulse rate was lowered, the nervousness, sweating and weakness decreased, the lost weight was regained, the untouched thyroid gland diminished in size and grew firm in texture, as after a successful ligation or a successful rest cure; and of equal significance, although the operation was much more severe and of longer duration than a thyroidectomy, there was but little postoperative reaction, that is, little so-called postoperative hyperthyroidism. And why should this not have been the case, for according to our point of view, part of the electric generative plant of the vegetative nervous system was removed! The result of this procedure was not as lasting as after the removal of one lobe of the thyroid gland. This evidence is too meager to be conclusive and is offered only as so much evidence in favor of our general thesis.

How interesting that the symptoms of hyperthyroidism are so completely "adrenal" in nature—the driven heart, the activated nerves, the increased metabolism, the sweating, the vasomotor instability, the dilated pupils, the increased pulse pressure, all of these show a sensitization due to adrenalin. What is accomplished so strikingly by merely cutting off the sympathetic nerve supply to the thyroid gland may apparently be achieved on a much greater scale by the removal of one of the generators instead of by merely severing some of the feed wires.

The thyroid is governed, at least largely, by its innervation; innervation is regulated largely by the adrenals; the adrenals are controlled by the brain and nerve centers, though chemical activity probably plays a rôle. The thyroid certainly cannot originate hyperplasia, the thyroid has hyperplasia imposed on it; the adrenal glands cannot stimulate themselves, stimulation is imposed upon them; the nerve receptors cannot engage in self-excitation, excitation is imposed on them by the physical and chemical forces of the external and internal environment. The entire nerve mechanism, the adrenals, the thyroid, and in a secondary sense other ductless glands, act reciprocally; that is, nerve tissue, the adrenals and the thyroid tissue collaborate in a stepping-up process, a stepping-up of activity. In certain individuals, because of some previously existing unknown factor, some chemical or physical unbalance, the normal controls become inefficient or are lost, and a reciprocal excitation continues after the environmental excitation that initiated the activity has ended.

PYLORIC OBSTRUCTION*

JOHN B. DEAVER, M.D., F.A.C.S.

PHILADELPHIA

THE opening through which the stomach and the duodenum communicate, the pylorus, is surrounded by one of the important sphincters in the body, both from a physiological and from a pathological point of view.

Anatomically this stoma is easily demonstrated on the living subject in the open abdomen. At first one sees the short, stubby, pyloric veins, the anterior being the more evident, then by traction on the stomach, pulling it upward and to the left, the pale circular ring at the site of the pylorus comes into view; or it can be demonstrated by invaginating the duodenal or the gastric wall directly through the opening. The function of the pylorus is that of regulating the traffic along what the Germans so aptly call the *Magenstrasse*, especially the control of duodenal regurgitation. This *Magenstrasse*, like other avenues of communication, is subject to traffic jams and we then have the familiar condition of pyloric obstruction. This may be due to a mechanical condition, or to a functional derangement which may be congenital or acquired.

Congenital hypertrophic pyloric obstruction is most commonly seen in infants, although it may fail to present symptoms until adult life, even after middle age. These adult cases may be mistaken and treated for ulcer or even cancer until operation reveals the true nature of the disorder.

Acquired pyloric obstruction has a varied etiology; its most frequent cause, as seen in the Lankenau Clinic, is ulcer of the duodenum by extension of the periulcerous exudate. We rarely see a juxtapyloric duodenal ulcer, and gastric ulcers likewise are usually distal to the pylorus on the lesser curvature, on the posterior wall near the lesser curvature, near the cardiac end, or on the anterior wall of the stomach.

In addition to ulcer, obstruction of the pylorus may be caused by tumors, cysts, and spasm of the circular muscle fibers of the terminal portion of the antrum, or by adhesions, the result of inflammation, binding the duodenum to the gall bladder, or to the under surface of the liver, a condition often seen in reoperation after cholecystectomy. In fact pyloric obstruction due to, and associated with, cholecystitis is not at all uncommon. It may, as already indicated, be the result of adhesions caused by the gall-bladder inflammation, compression in the pyloroduodenal region by an enlarged calculus, and a more or less adherent gall bladder, or a stone becoming wedged in the pyloroduodenal region.

A common condition, and one that presents many problems of etiology, diagnosis, and treatment, is incomplete obstruction due to pylorospasm. These cases require exhaustive study from every angle and especially from that of constitutional nervousness, and the nerve supply. The innervation of the stomach and its rôle in gastric disturbances is receiving ever-increasing attention; in fact, Charles H. Mayo has suggested division of the sympathetic nerve supply to the pylorus as a means of correcting pylorospasm. The stomach is supplied by the vagus and the sympathetic system; recent studies have shown the presence also of ganglia cells in the musculature and in the submucosa of the pylorus. In addition to the mixed supply from the aforenamed systems, the stomach is supplied by completely isolated sympathetic nerve branches.

It is entirely possible, indeed highly probable, that a neuritis or perineuritis of

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the gastric nerves may form the beginning of the derangement that finally leads to ulcer, and eventually to cancer. The first stage would be a gastritis, the result of nervous irritation (which has been produced experimentally), which recently is being emphasized as a potent cause of pylorospasm. That this is not merely a theory is evidenced by the common experience of patients who give a clinical history of ulcer while at operation no ulcer is found. It is in these cases that follow-up observations show unsatisfactory results. The influence of the nervous system in the etiology of ulcer and of pylorospasm may also be responsible for the periodicity of ulcer symptoms, as mysterious to the patient as to the practitioner.

The chief interest in pyloric obstruction is getting the patient well, in short, treatment. Organic obstruction due to cicatricial stenosis is entirely and permanently relieved by gastroenterostomy. This is the ideal condition for this operation, about which I believe there is no difference of opinion among surgeons. If the obstruction is the result of a high duodenal ulcer, which it is in most instances, the ulcer may be disregarded so far as any operative attack upon it is concerned, and merely a posterior gastroenterostomy made; also where the obstruction has been the result of a gastric ulcer, gastoenterostomy is the indicated procedure. In obstruction caused by a pyloric carcinoma that has not metastasized and offers itself for excision, subtotal gastrectomy is more promising from the standpoint of relief of symptoms and of prolonging life. However, for the operator of small experience in gastric surgery it perhaps will be safer to do only a gastroenterostomy. The surgeon of wide experience will not hesitate to do a subtotal gastric resection, provided metastasis is not too extensive. The presence of enlarged nodes in the gastrocolic omentum does not necessarily contraindicate partial gastrectomy. It is our practice to remove one or two of the nodes and submit them to immediate frozen-section examination. If the report is negative we regard the case a favorable one for excision, and even if carcinomatous, in the absence of ascites and jaundice, it does not deter us from making the more extensive operation. The judgment of the individual surgeon will best decide the question. Here is where experience counts for most. In short, gastroenterostomy in carcinomatous obstruction of the pylorus has not, in our experience, been as satisfactory as subtotal gastrectomy, as evidenced by the immediate postoperative comfort as well as the remote results. In fact, I am often more than amazed with some of the results of subtotal gastrectomy in carcinomatous pyloric obstruction.

On the other hand, where the carcinomatous mass obstructs the pylorus and is not confined to the pyloric end of the stomach but extends well to the cardia end along the lesser curvature, the question of doing any operation arises. This condition very nearly approaches that met with in the leather-bottle stomach which, in our experience, only occasionally lends itself to complete gastrectomy. Right here let me say, fixation of the pyloric growth does not always forbid removal. Our follow-up records show some very satisfactory results of operation for fixed pyloric carcinoma, as far as results can be considered good in surgery for this deadly disease.

Obstruction by benign tumor is rare. While it is possible for a benign tumor or cyst to act as an etiologic factor in obstruction of the pylorus, it is unusual but it should be thought of. Recently, in one of our cases, such a tumor was a pedunculated fibroma that sprang from the posterior wall of the stomach near enough to the pylorus to cause intermittent obstruction. It was because of the latter that surgery was resorted to.

Pyloric obstruction caused by adhesions does not, as a rule, appear until organization of the new tissue and contraction has occurred. In a small percentage of instances, for example where either the

pylorus or the duodenum or both have become plastered to the under surface of the liver, but especially to the site of repair of the gall-bladder fossa, I have had to make a gastroenterostomy because the patient was rapidly declining due to persistent vomiting and the resulting inanition. In these circumstances operation is not done precipitately; it is best to wait until it has been demonstrated by lavage or by the barium meal or the raisin test meal that the stomach does not completely empty and there is retention. I believe a certain percentage of remote morbidity and even fatalities following operation for gallstone disease are the result of failure to recognize the presence of pyloric obstruction and failing to make the anastomosis early. This is one of the postoperative surgical misfortunes, similar to intestinal obstruction or vicious circle after gastroenterostomy, both of which sequelae have cost lives that might have been saved by timely reoperation. From my experience I cannot too strongly stress the importance of quick action in making these secondary operations. Watchful waiting will not win out in these cases while looking and acting immediately will. In these conditions do not allow the medical consultant, who is often asked to see the patient when the secondary operation is advised, to tie your hands by counseling delay in order to try measures that, in my opinion at least, are absolutely useless in these mechanical conditions. I have been embarrassed by having this situation arise and unfortunately have been forced to be expressive and not always in too polite phraseology.

In passing, it may be said that in addition to ulcer and cholecystitis, perigastric adhesions may result from disease of the pancreas, hernia, and epigastric trauma. Any of these may so change the contour of the stomach as to involve the pylorus. In exceptional cases, obstruction may also be due to extragastric causes from pressure of a tumor in adjacent organs—the liver, gall bladder, intestines, pancreas, etc. There are also instances on record in which the clinical history pointed as clearly as possible to pylorospasm and obstruction, in which the clinical tests showed the presence of sugar in the urine as well as a high blood sugar content and in which the gastric symptoms were entirely relieved by treatment of the diabetic condition.

Of the functional causes of incomplete pyloric obstruction, the most difficult to satisfy oneself as to its cause is pylorospasm. In the cases of epigastric pain where operation does not expose a lesion and in the unoperated cases where careful clinical study and laboratory tests do not reveal it, and treatment brings no relief we, as a rule, make a diagnosis of pylorospasm. The question is, are we right? Unfortunately, roentgen-ray and fluoroscopic study do not always help so that we are frequently placed in a more or less embarrassing position when being interrogated by an over-anxious patient or his friends.

If pylorospasm, as is claimed by some, is fundamentally due to disturbance of the vegetative and pneumogastric nervous system, the best procedure, if no lesion can be demonstrated, is the removal of the pyloric sphincter muscle, either its anterior half or in its entirety, the dissection of which divides the filaments of the vegetative and pneumongastric nerve supply to the muscle. This operation was devised by Payr of Leipzig, in 1924, and has been successfully used by him in cases where no other cause of pylorospasm could be found.

The most promising cases for removal of the anterior half of the pyloric sphincter are, I believe, those in which pylorospasm is associated with hyperacidity, where no other cause can be found, and where medical treatment has failed to relieve. We know that the majority of cases of duodenal ulcer present a high acidity; therefore, may not pylorospasm be a forerunner of ulcer, and if arrested, as we believe it can be by this operation, may not the formation of ulcer be prevented? This question is certainly worth considering. We all know the systemic effect of

spasticity of other sphincter muscles, for example the muscle of Oddi, the ileocecal, and the rectosigmoid muscles.

In a number of cases when operating for gallstone disease or ulcer or both, where there was marked spasm of the pylorus, I have made a longitudinal section of the pyloric sphincter, a modified Rammstedt operation. As you all know, chronic gall-bladder disease and ulcer very frequently coexist and the disorder is practically always accompanied by pylorospasm. This is true, also, of chronic appendicitis, especially where the appendix occupies a high position. Chronic pylorospasm, therefore, is not an unusual condition and cannot always be relieved by the removal of the major lesion, and if left undisturbed there may result a true hypertrophy with subsequent incomplete obstruction. When exploring the upper abdomen I always make a point of calling the attention of my students to the possibility of this functional pyloric defect, and when it is present I am able to demonstrate it very clearly by irritating the angry pylorus by striking it lightly with the blunt end of the scissors or the handle of the scalpel.

Prompted by the good end-results of the cases in which I made the longitudinal section of the pyloric sphincter and also by Payr's reported success with removal of the anterior half of the pyloric sphincter in functional pylorospasm, I concluded, after much thought that if Payr's operation was successful in functional pylorospasm it would be worth a trial in duodenal ulcer sufficiently distal to the pylorus to permit removal of the anterior half of the muscle, the idea being to do away with the necessity of gastroenterostomy and the possibility of subsequent marginal ulcer. I am now treating some duodenal ulcers in this way, when feasible. Where there is periulcerous exudate about the pylorus, the operation is out of the question because the dissection for removing the muscle must be carried down on the anterior duodenal wall. I have been able to do the operation in small bleeding ulcers where I always excise the ulcer, also in a few cases of acute perforated ulcer. The dissection is a delicate one requiring great care to avoid incising the mucous membrane. Up to the present my results have been satisfactory. It has been suggested, and in fact carried out by Payr's assistant, Kortzeborn, to remove the posterior as well as the anterior half of the muscle by opening the gastrohepatic omentum and carrying the duodenum forward. I have not yet done this because I have not given it sufficient consideration. The rationale of removing the anterior half of the pyloric sphincter muscle is like that of gastroenterostomy, namely to allow the regurgitation of the duodenal contents to act upon the stomach contents and thus neutralize the acid gastric juices and also to afford better drainage of the stomach. I wish to add that this operation does not apply to infantile congenital hypertrophic pyloric obstruction for which condition the Rammstedt operation still holds first place.

VALVULAR THORACOTOMY FOR EMPYEMA*

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NEW YORK

THIS operation is apparently an old one; but little mention has been made of it in modern times. My attention was called to it by an article in the memorial volume to Prof. E. Forgue of Montpellier, France.

We have only a small series of cases; but the results obtained so far would seem to justify a further trial of this operation, and it seems to have some advantages over the customary procedures.

The three main features are:

1. *Valve Action.* A flap of skin and subcutaneous tissue which overlies the incision in the pleura and acts as a valve and imitates the natural mechanics of the thorax. On inspiration the cavity tends to become emptied of its contents, purulent material and air; with the collapse of the chest on expiration the flap is sucked into the hole and prevents the entrance of air, favoring of course the descent of the lung.

2. *Elimination of Tube Drainage.* Drainage is made by introducing one or more sheets of dental rubber dam, a generous portion being allowed to protrude within the thoracic cavity. We find this method of drainage ample and have been able in these cases to discard the use of a tube. The prolonged use of a tube has many disadvantages. It sometimes causes pressure necrosis on the ribs and invites the formation of long stiff-walled sinuses. Introduction of the dam is painless.

3. *Elimination of Rib Resection.* Possibly the greatest advantage is that so far we have been able to get perfectly satisfactory drainage without rib resection and its complications. As rib resection is unnecessary these operations can be performed with the greatest of ease and absolutely painlessly under local anesthesia and without shock, a great advantage in dealing with the desperately sick patient.

OPERATION

A suitable dose of morphine is administered (to adults) a half hour before operation.

The operative field is liberally infiltrated with ½ per cent neocaine solution. The flap is planned so that its center corresponds to the middle of the intercostal space to be entered. A rectangular flap about 2 inches by 5 inches, with the base above, is made. The flap is made rather large as when released it shrinks. It consists only of skin and subcutaneous tissue. Before penetrating the pleura an aspirating syringe should be reintroduced, definitely locating the pus. (Fig. 1.)

The intercostal tissues, after infiltration, are incised widely and the pleura opened. As the wound will not be very wide it should be quite long. A sheet of rubber dam a little wider than the flap, is introduced into the thoracotomy wound. (Figs. 2, 3.)

Originally we made various efforts to secure the rubber dam in place by suturing it either within the pleural cavity or to the external intercostal muscles. Subsequent experience shows that such suturing is unnecessary.

This procedure does not shock the patient at all. We make no attempts to evacuate the pleura at the time of its opening, preferring that this evacuation should take place gradually, as the patient is not so apt to be distressed by coughing.

The patient can take his usual nourishment at once and subsequent convalescence is simple. The rubber dam if not

* Submitted for publication April 1, 1929.

sewn in place is renewed, usually daily or every other day, according to the amount and offensiveness of the discharge. Should drainage seem to be imperfect or obviously so thick as possibly not to escape freely, irrigations from time to time with Dakin's solution will remedy the condition perfectly.

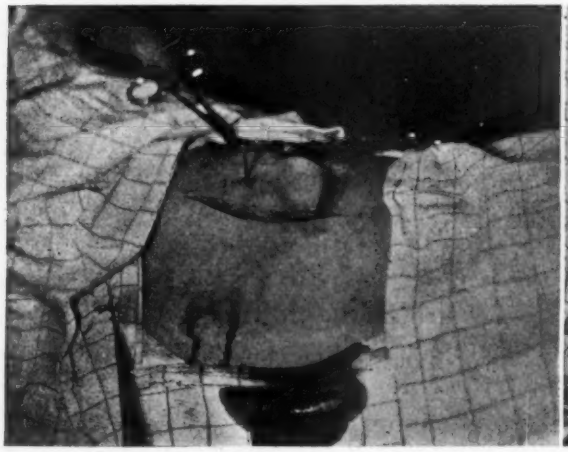

FIG. 1. Flap operation for empyema. First stage.

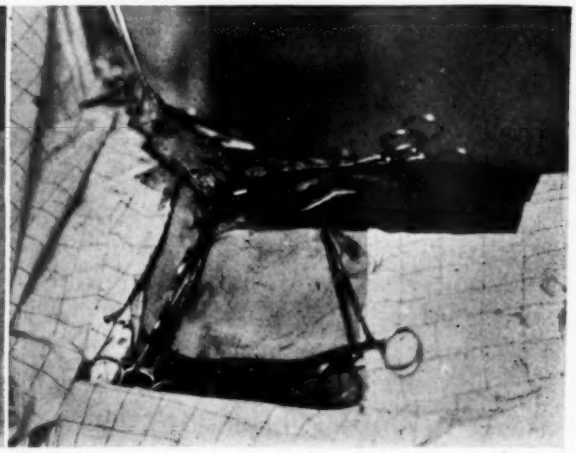

FIG. 2. Flap operation for empyema. Second stage.

CASE REPORTS

We can report on 12 cases, although in only 8 was a typical flap operation done. We are including the others because some feature of this operation was employed, particularly the use of rubber dam. These operations have been done by several different operators, most of them by myself.

There were two deaths in this series. I mention them for the sake of completeness although the existing conditions really are not suitable for contrast with the others.

CASE IV. Rose B., aged forty-two years. Transferred from Medical Service practically moribund on May 23, 1928. Under gas oxygen anesthesia a typical valvular thoracotomy was performed with rubber dam drain. Oxygen tent was immediately applied but condition grew steadily worse and died night of operation. Post-mortem examination revealed a large collection of fibrin beneath the right diaphragm and a patent foramen ovale in the heart. Culture showed Bacilli Friedlander, also gram positive bacillus which would only grow in fluid medium under anaerobic conditions.

CASE IX. Lawrence W., aged two and one-half years.

Operation January 30, 1926 under ether anesthesia. Incision in 7th interspace evacuated considerable amount of pus. Rubber dam drain was inserted. On the 11th postoperative day, when child's condition had been perfectly good, he began to have a rise in temperature and subsequently developed measles. He was transferred to Willard Parker Hospital where he died.

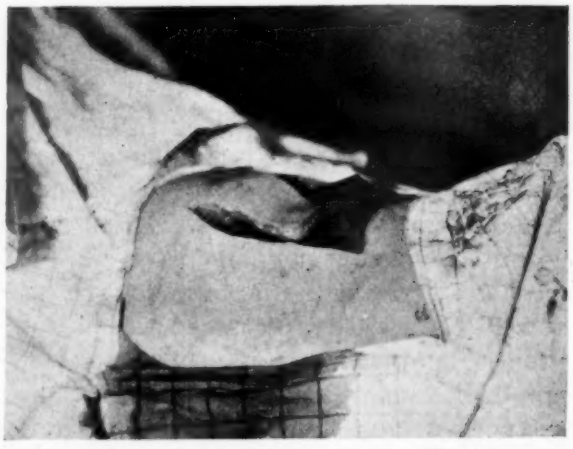

FIG. 3. Flap operation for empyema. Third stage.

(It will be noted that this is not a flap operation.)

Culture of chest fluid showed non-hemolytic green-producing diplococcus. Identification of this organism was incomplete because subcultures failed to grow.

Of the eight typical cases the following is the abstract. One has already been

quoted as a fatal case. Six of the remaining 7 cases were done by me, all under local anesthesia.

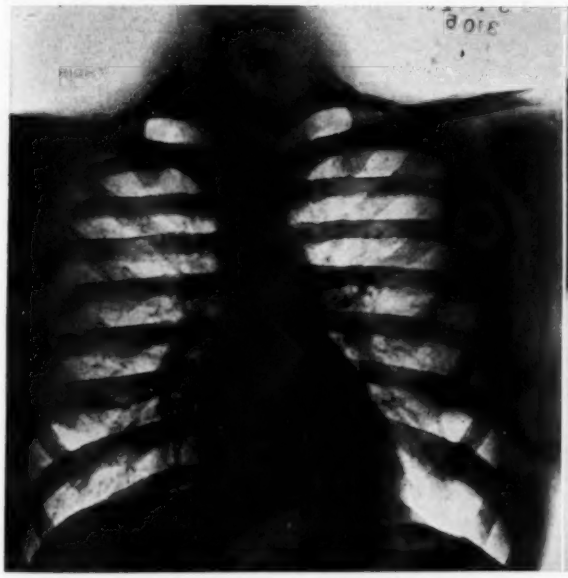

Fig. 4. Roentgenogram of Case I, taken four years after left valvular thoracotomy. No evidence of empyema.

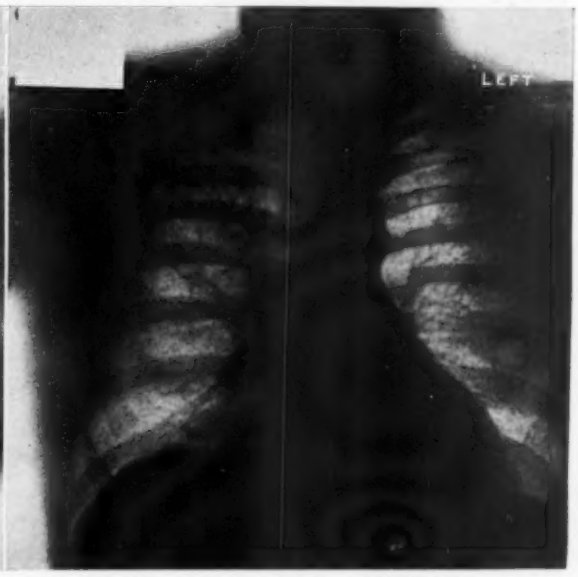

Fig. 5. Roentgenogram of Case II, taken one year after left valvular thoracotomy. No evidence of empyema.

Case I. Vito S., aged sixteen years.

Pneumonia five weeks previously, subsequently empyema.

Operation February 26, 1925. Drainage was made in the 7th interspace with typical flap under local anesthesia. Much thick pus was evacuated. Rubber dam was sutured to soft parts below 7th rib. Culture showed Streptococcus hemolyticus.

Discharge had ceased on the fifteenth postoperative day. Patient was discharged twenty-five days after operation in good shape.

Follow-up: January 17, 1926. Excellent condition. Gained 40 pounds.

March 27, 1929. Excellent health. No complaints of any kind. Chest expands normally and breath sounds are heard to the base. Roentgen-ray report: "The only evidence remaining is flattening of left diaphragm with obliteration of left costophrenic angle. Hilus shadows moderately increased; but no sign of pulmonary disease." (Fig. 4.)

Case II. William T., aged forty-four years.

Admitted to Medical Service with lobar pneumonia. Transferred to Surgical Service and operated on March 14, 1928 under local anesthesia, with typical flap and rubber dam drainage, secured by catgut suture below the eighth rib. There was much drainage. Culture showed Streptococcus non-hemolyticus.

There was apparently some backing-up of pus. Carrel-Dakin treatment was instituted for five days, with immediate improvement. Patient was discharged on twenty-eighth postoperative day with discharge entirely ceased, and lung quite well expanded.

Follow-up: October 4, 1928. Working hard. Lung resonance normal. Gained 40 pounds.

Roentgen-ray examination March 7, 1929: "Shows moderate fibrosis manifested by accentuation of linear markings." (Fig. 5.) Still in splendid condition and working hard.

Figure 6 shows appearance of flap a year after operation.

Case III. Catherine C., aged four and one-half years.

April 7, 1928: Roentgenogram showed signs of fluid in left chest. Aspiration yielded pus.

Operation April 21, 1928 under ether anesthesia: Thoracotomy with typical flap through 7th interspace. Large amount of thick yellow pus was evacuated. Culture showed pneumococcus Group I. Rubber dam inserted in cavity and sutured to lower edge of pleural cavity. Convalescence was rapid. Wound all healed and patient sent to country on twenty-fourth postoperative day.

Follow-up: March 21, 1929. Excellent condition. Roentgen-ray report: "Hilus shadows and

linear markings slightly increased. Diaphragm low and smooth and no longer any evidence of empyema." (Fig. 7.)

Roentgen-ray, Mar. 27, 1929: "The left thoracic cavity is smaller than the right. Diaphragm is low; but shows dense adhesion at its dome. Linear markings definitely increased in upper lobe of left lung with considerable studding and hazy increase in density near apex, probably due to thickening of pleura and also infiltration in lung. Trachea deviated to left; heart and mediastinum also slightly displaced to left. Changes indicate old pleuritis with fibroid tuberculosis at the apex. No longer any evidence of an empyema." (Fig. 8.)

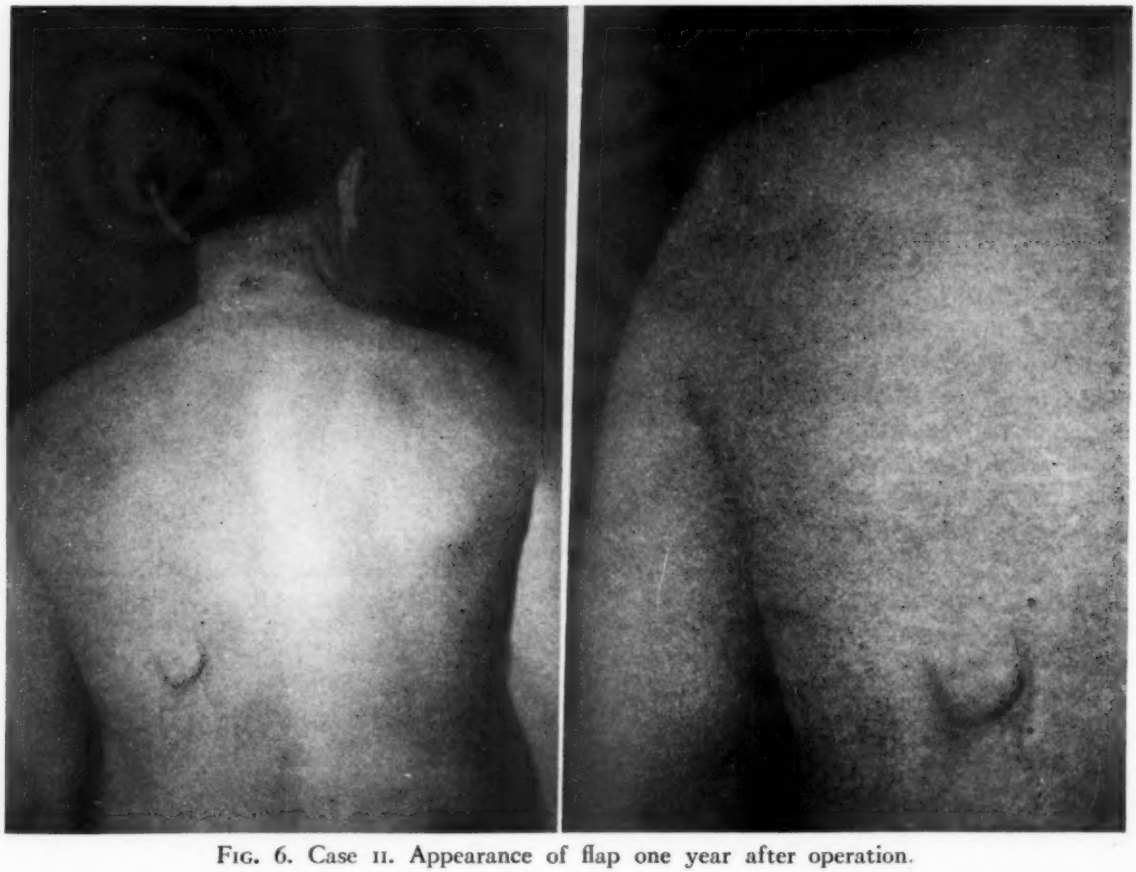

FIG. 6. Case II. Appearance of flap one year after operation.

CASE IV. Rose B., aged forty-two years. (This case has already been quoted as a fatal case.)

CASE V. Christopher D., aged forty-seven years.

Admitted to Medical Service November 5, 1928, with lobar pneumonia. Under local anesthesia typical flap operation was performed. Much pus was evacuated. Rubber dam was inserted and anchored to edges of intercostal wound. Culture showed pneumococcus Group II.

Temperature gradually came down and remained normal for four weeks. On discharge thirty-second postoperative day wound was healed. Roentgen-ray picture showed no evidence of fluid in cavity.

Follow-up: March 21, 1929. Working. Excellent condition. Gained weight. Chest expanded normally and breath sounds were heard down to the base.

CASE VI. Josephine F., aged twenty-eight years.

Admitted to Medical Service November 13, 1928, with pneumonia. Transferred to Surgical Service November 24, 1928. Under local anesthesia typical flap operation was performed. Considerable thin purulent fluid, evacuated. Rubber dam drain was sutured to opening externally. Culture, showed pneumococcus Group II.

Patient was discharged on twenty-third postoperative day, wound practically healed.

Follow-up: March 21, 1929. Lung expanded fully and breath sounds were heard all the way down to the base. Flap had healed firmly and

Fig. 7. Roentgenogram of Case III, taken eleven months after left valvular thoracotomy. No evidence of empyema.

was not sensitive. Excellent condition. Gained much weight. Roentgen-ray report: "Hilus shadows moderately increased; linear markings normal. No evidence of thickened pleura or any remains of previous empyema." (Fig. 9.)

Case VII. Thomas C., aged fifty-two years. Admitted to Medical Service January 23, 1929, with pneumonia. Transferred to Surgical Service, and operated on March 5, 1929. Under local anesthesia typical flap operation was performed. Culture showed pneumococcus Group IV.

Rubber dam drain was sutured in place to the external intercostal muscles. Patient is still under treatment; doing extremely well.

Case VIII. Frances C., aged thirty-nine years.

Pneumonia some time prior to February 11, 1929. Blood culture showed Group IV pneumococcus. Four days before admission signs of effusion in left pleural cavity, proved by aspiration.

Operation March 11, 1929. Under local anesthesia typical flap operation was performed. Rubber dam was sutured to external intercostal muscles. Patient is still under treatment; very well although there was a very large amount of pus.

The following are not typical flap operations, but are cases in which some feature of the operation was employed:

Case IX. Lawrence W., aged two and a half years.

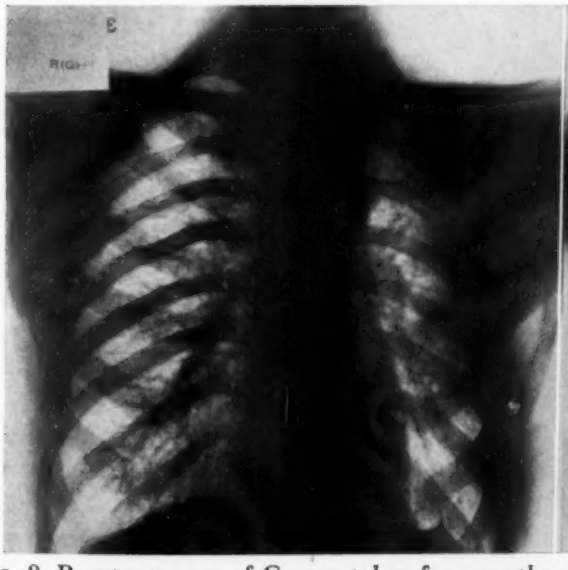

Fig. 8. Roentgenogram of Case V, taken four months after left valvular thoracotomy. No evidence of empyema.

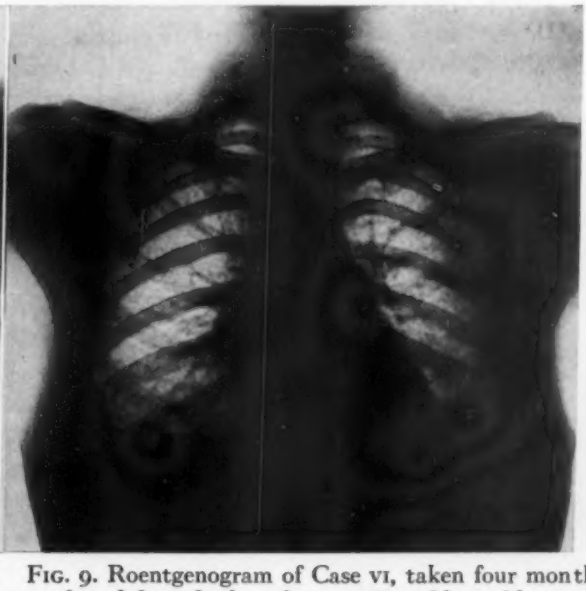

Fig. 9. Roentgenogram of Case VI, taken four months after left valvular thoracotomy. No evidence of empyema.

(This case has already been quoted as a fatal case.)

Case X. Francis S., aged one year.

Operation Jan. 27, 1926 under ether anesthesia: Incision in 6th intercostal space, drained with rubber dam. Culture was negative. (Not a flap operation.)

Convalescence was very slow, complicated by rickets and malnutrition, and patient believed also to have measles.

Follow-up: March 21, 1929. Patient has grown and developed normally and is in excellent condition. Breath sounds are a little below normal around wound. Roentgen-ray report: "No longer any evidence of empyema. Diaphragms both smooth. Hilus shadows and linear markings of normal intensity. Bony fusion between the 5th and 6th ribs posteriorly."

Case xi. Adolph E., aged fifty-one years.

Operation May 24, 1928 under gas oxygen anesthesia. Valvular flap was made but on account of seeming closeness of rib, operator decided to resect 1½ inches of the 7th rib. Culture of fluid was negative.

Convalescence was slow. Patient was discharged on the eighty-third postoperative day with small amount of drainage from the thoracic sinus. Roentgenogram showed definitely thickened pleura and partial contraction of lung. No fluid was present.

Wound was reopened December 6, 1928. Old sinus was explored and found rib had regenerated so as nearly to close off the opening. This new rib was removed. Only a small cavity was found with considerable thickened pleura. Wide opening was left for drainage.

Follow-up: March 21, 1929. Left chest did not expand fully and there was almost complete absence of breath sounds at the base. There were some exuberant granulations in the wound from which there was slight discharge. Sinus was healed.

Case xii. Thelbert P., aged fifteen years.

Operation March 6, 1929 under local anesthesia: Incision made in 8th interspace and considerable pus evacuated; rubber dam drain inserted into cavity. Culture showed pneumococcus Group 1.

Skin flap had been outlined; but it was found subsequently not to cover the incision and therefore should not be counted as a typical operation.

Patient is still under treatment and improving. He had been treated medically for fifty-two days before being transferred to Surgical Service.

CONCLUSION

Our final impression is that the patients have made a somewhat quickly response to operative treatment and convalescence has been smoother.

As regards the period of complete healing it is hard to express any definite statement as conditions vary so much; but they certainly have been fully as prompt as the average.

Particularly gratifying are the follow-up results in which all patients have shown very marked restoration to health and physical examinations (which on several occasions have been confirmed by competent internists), have shown complete restoration of normal function of the lung. Finally the roentgen-ray results give certain proof of the complete permanent cure of this condition.

THYROIDECTOMY TECHNIQUE

THE POSTOPERATIVE CARE OF THE TOXIC GOITER PATIENT*

DONALD GUTHRIE, M.D., F.A.C.S.

SAYRE, PENNSYLVANIA

THE technique of thyroidectomy has become so refined and so standardized that perhaps one should offer an apology for discussing the operation, but there are certain points in its performance which, if kept constantly in mind by the surgeon, will safeguard the patient against certain operative accidents and postoperative complications that are serious and often fatal.

The majority of deaths in former times was due to postoperative hyperthyroidism, but the modern methods of preparation of the goiter patient for operation have greatly lessened the dangers of this complication and it is no longer to be greatly feared by the experienced surgeon. The mortality today is largely due to complications that arise during and after the operation; those which arise during the operation are cardiac failure, massive hemorrhage, and suffocation due to injury to both recurrent laryngeal nerves and collapse of the trachea; those which arise postoperatively are hemorrhage, either massive or concealed, asphyxiation due to injury to both recurrent nerves or obstruction of the trachea from postoperative tracheitis, and mediastinitis from infection and pneumonia. Unquestionably a very frequent cause of death today is postoperative hemorrhage.

Efforts directed entirely to the prevention of these complications are, in the writer's mind, worthy of discussion, and for this reason a brief description will be given of a technique which has been used in our clinic for several years.

We employ a modified anoci-technique in that no patient knows the day of the operation. The night before is spent in restful sleep and in the morning, one-half an hour before the operation, the patient receives a hypodermic of morphine and atropine instead of the hypodermic of sterile water that has been used upon several previous mornings. She goes to the metabolism room believing that she is to have another test, but ethylene is administered instead. The attending physician and the members of the family do not see the patient before the operation. We use ethylene routinely in our surgical work and believe it especially valuable in thyroid work because it does not stimulate respiration or cause an increase in the secretion of mucus. The skin remains closed and the patient thus loses no fluids during the operation. We are unable to announce bluntly to our patients the time the operation is to be performed without causing mental and emotional excitement with a marked acceleration in the pulse rate. We have many charts to show the rapid rise in the pulse curve after this announcement has been made. This acceleration in the pulse continues during the night, is present in the morning and is markedly accelerated during the operation. A patient thus excited and stimulated is much more prone to develop postoperative hyperthyroidism than one not so stimulated. Another advantage of our method is the removal of an unnecessary additional cardiac load, which may not have an immediate effect, but a remote one upon an already strained and damaged myocardium.

There is no type of operation which calls for better team play than thyroidectomy. The first assistant should be a well-trained man and should work constantly with the

*Read at the Annual Meeting of the American Association for the Study of Goiter, Dayton, March 25–27, 1929.

surgeon; the second assistant should also have training if he is to be a member of the goiter team. The operating room nurse is a valuable member of the team also; for if emergencies arise, delay upon her part may be fatal.

Should the surgeon use inhalation anesthesia in his work, the anesthetist should be one with a wide experience and special training in thyroid work. I know of no better way to safeguard the goiter patient than to have the anesthetic administered by one with skill obtained from a wide experience.

In order to do safe thyroid surgery, wide and ample exposure should always be obtained; the flaps should be widely separated and a single or double trap-door exposure should be made if necessary. The sternomastoid muscle may be separated from the sternothyroid and retracted outward to increase the exposure. It is wise at this step of the operation to ligate all the bleeding vessels; it is poor technique to have a dozen or more clamps in the wound before the attack upon the thyroid is begun. The sternothyroid muscle should be completely freed from the gland. It is best to lift the thyroid out of its bed by dividing the lateral thyroid veins before attempting to ligate either pole. In our clinic we do not rely entirely upon a mass ligature to secure the vessels of the upper pole but we believe that it is safer to ligate the individual vessels themselves, i.e., the superior thyroid artery and vein lying to the inner side of the pole; the descending branch lying behind the pole and the outer branch are clamped and divided separately. This technique is more troublesome and tedious but we believe it is safer than the mass ligature. It is, of course, important to be sure that no fibers of the severed muscles are included in the single or multiple ligatures as this will greatly increase the danger of postoperative hemorrhage. In the multiple ligature method it is surprising at times to observe with what ease long, tongue-like extensions of the superior thyroid pole may be rolled downward into the wound, often the vessels are divided, obviating the necessity of the wide upward exposure that is necessary when the pole is ligated with a single ligature.

We leave strips of thyroid tissue at both upper poles along the trachea, thus protecting the recurrent laryngeal nerves which lie close to the thyroid in this position, especially near the horn of the cricoid cartilage where the nerve comes forward out of the groove between the trachea and esophagus to enter the larynx behind the articulation of the inferior horn of the thyroid cartilage with the cricoid. If the horn of the thyroid cartilage is located with the finger and strips of thyroid are left superficial to this area there will be little danger of injury to the nerve. To protect the nerves at the lower pole, the forceps are placed parallel to the long axis of the neck high upon the gland and are never rotated during the ligating of the vessels. It was formerly thought that the lower pole was most frequently the site of nerve injury, but it is now well known that the injuries take place most frequently in the groove between the esophagus and trachea or near the upper pole. Operations upon injured nerves bear out this statement.

It is very important that the trachea should not be traumatized during the excision of the gland by rough handling or a too clean dissection, if the patient is to be spared postoperative tracheitis or temporary abductor paralysis, conditions which subject the patient to the risk of pulmonary complications. With this in mind, we have developed in our clinic what might be called an ever-changing attack upon the gland. The dissection continues in a direction that is compatible with absolutely quiet respiration, the direction of the attack being changed at once if the patient emits the slightest exaggerated respiratory sound.

Should the gland be substernal in type, we use the primary superior polar attack, believing that there will be less trauma to

the trachea and less danger of immediate massive hemorrhage from the deep inferior vessels. In the presence of a severe hemorrhage care and patience should be used in securing the vessel itself, as it is extremely dangerous to attempt to catch the vessel in a pool of blood. This hemorrhage may often be controlled by pinching the vessel back of the capsule with the fingers, which will enable one to clear the cavity of blood and catch the vessel accurately.

If the superior pole is ligated first and the gland further mobilized by ligating the lateral veins and the descending branches of the superior thyroid artery, it is surprising to see with what ease large substernal masses can be gently and easily delivered from the mediastinum—a much safer plan than first to deliver the substernal mass hurriedly into a wound that is already crowded with thyroid.

After the lobe has been removed all vessels are completely and securely tied with very fine catgut. We do not regard the simple granny knot as safe unless fixed by an additional tie.

The raw surface of the remaining thyroid should be given most careful attention and the oozing should be controlled by many ligatures or by careful whip stitching. In the hyperplastic gland this step in the operation may be very tedious and the parathyroids and the recurrent nerves may be subjected to trauma by placing the sutures too deep in the remnant of the gland. We have frequently left one or more hemostats upon the remnants of the gland after using a reasonable amount of effort to control rebellious oozing or we have occasionally used a small gauze pack.

We employ drainage in almost every case but remove our drains at the end of twenty-four or thirty-six hours. I am satisfied this drainage is sufficient in the majority of toxic cases to safeguard the patient against dangerous postoperative pressure symptoms or mediastinitis.

The patients in our clinic are all treated in private rooms, whether they are pay or charity cases. They are not left alone even for a few minutes. Severe postoperative hyperthyroidism is treated by morphine given in quantities sufficient to ensure rest; fluids, glucose and ice are used to control the temperature. The patient is carefully watched for postoperative massive hemorrhage or postoperative concealed hemorrhage and help is sought at once if the attendant is the least bit suspicious. The lives of five of my goiter patients have been saved by prompt and intelligent action upon the part of my junior resident staff. Every effort should be made to keep the trachea free of mucus, because an excess of mucus subjects the patient to the risk of aspiration pneumonia.

If the operation has been severe and there is great pain and difficulty upon swallowing, we use to great advantage an inlaying nasal tube, first suggested by Bartlett. Absolute quiet for a day is maintained; the patient sleeps much, is kept out of drafts and the trachea is kept free of mucus if possible.

Great care must be taken in the surgical management of the wounds, for these patients do not withstand wound infection well.

One can never afford, even though his experience in thyroid surgery becomes large, to be careless or rough in his operations upon the thyroid gland nor can he disregard the importance of meticulous postoperative care, for it is attention to these details in the management of goiter patients that spells success.

THE FIELD OF ELECTROSURGERY*

HOWARD A. KELLY, M.D., F.A.C.S.

BALTIMORE

IN spite of an evident slowly growing appreciation of the value of electrosurgery, the extensive application of this new principle still remains limited to the few more or less specializing in this field. My present plea is for its wider adoption as indispensable in our daily practice as general surgeons, in all our hospitals and above all in our teaching centers, that our young men may catch the inspiration of these radically new methods and carry them on to perfection.

The difficulties are those of all new ventures; as established, successful general surgeons we naturally grow set in our ways and look askance at radically new principles. The notion is also curiously current that electrosurgery is but another, perhaps somewhat more convenient and refined way of using the ancient hot iron and, therefore, negligible to that extent. An added objection of the *prima facies* sort is that it calls for switchings and sundry manipulations which are sources of delays and inconveniences. Further discouragement follows the discovery that it is after all not quite so easy of effective application as anticipated.

Noting these and other objections and making my most conciliatory bow to the objectors, I still insist that our younger men, with pliable brains and flexible fingers, should be given every chance to take the matter in hand and judge for themselves, for I have a supreme confidence that once turned into these inviting new channels, they will develop a refined and efficient surgical technique which will astound the next generation and help to mark a new era. Let me here stake any reputation I may have for prophetic vision and let the future decide.

The comparisons I shall make relate wholly to the usages of general surgery and the new electrosurgery. Radium and ray therapy I am not considering, as foreign to my immediate purpose. Nor shall I mention the electric principles involved, nor the apparatuses and various new tools fashioning themselves spontaneously under our hands as the field grows more familiar and its scope widens. Rather let me attempt to define the field itself and the opportunities it offers to the electrosurgical therapist. I first call attention as a background to some objectionable features in our general surgical work, to which we have become so accustomed that we are inclined to pass them over as negligible.

There is, for example, the more extensive use of a general anesthetic with its many drawbacks; the greater loss of blood, or, if the operator is meticulous in catching every vessel, in any big operation a painful loss of time; the objectionable, manipulative contacts with the tissues; the frequent, somewhat ruthless, clamping and crushing of tissues, especially when the bleeding vessel is not easily accessible; also, the numerous ligatures used, often preventing the advancement of the operation in a particular direction. In malignancy, the operator is often precluded from following up the invasion, owing to the impossibility of a clean unquestionable removal with scalpel or scissors. In our classical exsective surgery, in malignancy, experience teaches that it is almost invariably a matter of one throw of the dice, that everything must as a rule be done at the first sitting, for secondary operations supplementing the first are usually futile.

It is often impossible effectively to sterilize an infected wound. Ligatures and sutures are objectionable foreign bodies. Convalescence is often slow with much pain from the divided nerves and a resultant inferior scar.

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Let me contrast our electrosurgery with this, with malignancy in view *par excellence.*

A simple sewing needle, a long stiff pointed wire, or a small flat disc are our common instruments. The concept of the surgical field, the arena of attack in a particular case, is identical with that of the general surgical viewpoint; the area to be handled aggressively is the same, the difference lying in the method of attack. There is, for example, the condemned umbra, the focus of the manifest disease and there is its circumambient penumbra, the encircling zone, more or less normal to the eye but practically always invaded by microscopical elements responsible for the too frequent recurrences *in loco.* Distressing experiences have taught us long since to make this penumbra ever wider and yet again wider. When the malignant invasion lies close to an eye or to the nose or about the mouth, however, the judgment of the best general surgeon is too often biased in his anxiety to avoid deformity, so he takes an unwarranted chance in lessening the penumbral area and risks a larger liability to a recurrence. Electrosurgery goes without hesitation to and beyond the prescribed limit, assured of a rapid recovery with pliable cicatrix without traction.

In electrosurgery, even extensive operations are often feasible under local anesthesia, classifying them in the ambulatory class.

An infected or ulcerated area can be sterilized with a thorough coagulation; the surrounding area is painted with 5 per cent mercurochrome, and a fine needle is plunged vertically into the tissues at the outer margin of the penumbra, in this way sequestrating or cutting off the whole area, cooking both nerves and vessels, lessening pain and bleeding and hastening extirpation.

George Wyeth's cutting current (acusector) is then used with surprising neatness and facility to undermine and lift the circumscribed area off in one sheet, reducing the liability to infection. Following this superficial extirpation, when the disease extends into the depths, the underlying areas are coagulated or desiccated and curetted away like soft cheese or removed in blocks by the acusector.

In this way the operation advances deeper and deeper until well beyond every suspected area, working easily it may be within narrow restrictions or at depths extremely embarrassing to the scalpel, such as well back in the throat, high up in the rectum, up in the bladder, deep in the pelvis or upper abdomen, or even down in the esophagus or in destroying a polyp in a bronchus!

Larger vessels seen in advance are isolated, caught, divided, and coagulated, and so sealed without a ligature, avoiding awkward delays, crushing tissues, and tedious insecure efforts at ligation. The best way to stop hemorrhage is to isolate the vessel as nearly as may be on the point of a forceps and then merely to rest the energized needle on the shank of the forceps, effectively sealing the vessel in a few seconds (Ward).

Healing *per primam* is the rule.

Categorically, and in some measure recapitulating, the superior advantages of electrosurgery are the following:

1. It destroys the tissues by a prompt necrobiosis in loco. In destroying, it sterilizes, rendering even seriously infected wounds innocuous.
2. It greatly reduces hemorrhage.
3. The tissues are not handled, squeezed, or compressed, but treated in situ and left to be thrown off or absorbed. There is no carbonization.
4. The use of ligatures is largely avoided.
5. The depth of the tissue from the surface, embarrassing to the general surgeon, is not a difficulty in electrosurgery.
6. The field of operation is reduced in size and limited to the extent of the disease or suspected area and does not in any way compromise the surrounding noninfected areas.
7. The depth of the destruction, easily

regulated to a millimeter or a fraction of a millimeter, can be extended at will, in marked contrast to the use of the Paquelin or the ordinary cautery.

8. The number of complications is greatly reduced.

9. There is as a rule no interference with primary union.

10. There is less pain following the operation and less after-use of sedatives.

11. Grafts take readily where large areas are left exposed to be epithelialized.

12. A recurrence of malignancy in a limited area is easily treated at any convenient time in the convalescence.

I would note the use of electrosurgery as preeminent in the following fields:

Infected and metastatic glands are often not dissected out but destroyed in situ and without interfering with the surrounding circulation. Following such a thorough treatment the wound can be closed, and the sterile, dead tissues left to absorb; or, it may be advisable to curette away its contents and then to destroy its capsule. Glands on the pelvic floor and in the crotch of mesenteric vessels are best treated in situ.

Infected small cysts, or cysts with superficial papillary growths can be sterilized completely.

Hemorrhoids especially are admirably treated by this electrocoagulation.

In the fractious adenomyomas high up in the rectovaginal septum, the treatment may be limited to the area affected and any neglected areas followed up speedily.

Electrosurgery is destined to remodel, I think, our treatment of breast cases; as for example, in dealing with the infra- and supra-clavicular glands, sometimes sterilizing them and leaving them in situ to be absorbed. To do this with safety, the operator must have experience with the method. The question of danger from the intervening lymph channels must also be settled.

As Ward has shown, an obstinate ranula can be treated in this way by simple incision, evacuation, and coagulation ("coction") of its lining membrane, followed by closure. This I conjecture may also prove to be the best possible treatment of a hygroma which is opened and evacuated and the whole inner wall destroyed by coagulation or a heavy desiccation current and the incision closed.

I have treated a Bartholin cyst in the same manner.

In a large peritoneal hernial sac, I have coagulated the whole lining membrane rapidly and then left it in situ.

Papillary or cancerous implantations on the peritoneum are easily disposed of in this way, smaller ones in a fraction of a second—an enormous advantage over previous methods of excision and checking the hemorrhage by styptic, ligature, or suture. Implants on and infiltrations of the wall of the bowel, even extending through to the mucosa, can be rendered innocuous in loco and excluded in the direction of the bowel by sewing the adjacent peritoneum over them.

Omental metastases close up to the margin of the bowel can be destroyed with great security and without loss of blood.

I believe we shall find a field for electrosurgery in stomach operations for malignancy, in destroying the glands along the greater or lesser curvature and removing less of the organ. An enlarged gland felt deeper in above the stomach can also be destroyed in this way. We may, too, in time come to the excision of doubtful gastric ulcers with the electric needle, followed by direct suture, as preferable to our present more radical methods.

This treatment promises well in duodenal ulcer.

Electrosurgery is proving extremely effective in malignant diseases of the throat and of the upper jaw and in cooperation with radium.

In thyroid surgery, it may prove wiser to make a simple small incision, exposing the gland, to destroy a definite area by electrocoagulation, instead of the more time-consuming operative removal.

Harvey Cushing of Boston is opening up a wide field for electrosurgery in brain

and neural surgery, and Walter E. Dandy of the Johns Hopkins is advancing on similar lines. It takes but little imagination to envisage the numerous applications possible here.

In bladder surgery, in the removal of tumors and in dealing with ulcers either through the cystoscope or a suprapubic incision, we have a most fruitful field which we are only just entering.

The treatment of pigmented nevi is one of our triumphs; here one readily does a thoroughgoing satisfactory coagulating operation over an extensive area.

Electrosurgery is of great service in rectal carcinoma, cutting down the amount of disease to be radiated and even in attacking it in its invasion of the bowel wall, associated with the simultaneous direct application of heavy dosages of radium.

A danger in electrosurgery is in dividing muscular tissue, say, for example, the pectoralis major, close to a large vessel, where a sudden twitch may cause a momentary contact with a vessel and a serious hemorrhage, such as I have seen. There is also a danger in skeletonizing a small vessel up to its entrance into a trunk and holding it in a forceps and coagulating it. In such a case, the current strikes the trunk at the point of attachment to the big vessel in full force, risking a slough at that spot.

As a corollary to the above, one may add that the preparations for an electrosurgical operation, surrounded with all the necessary precautions for securing and maintaining a well-sterilized wound, are often not so extensive and time-consuming as for the average general surgical procedure, nor does the newer procedure entail the anxious after-care or anticipation of disagreeable sequelae.

This method, involving the adjustment of electricity in its higher potencies to the surgical field, is but a step in full accordance with the progressive scientific spirit of the age which today is predominantly electric. I venture to aver that these methods are far more surgical in the higher sense of the word in many cases than some of the cruder ways of general surgery as practised throughout the ages.

ISCHEMIC PARALYSIS*

DEAN LEWIS, M.D., F.A.C.S.

BALTIMORE

ISCHEMIC palsy or contracture is probably much more common than it is generally considered to be. It is certainly much more common than one would be led to believe from the number of cases appearing in the literature. In many instances the change is so slight that recovery occurs without any residue. In many instances the severer grades of palsy are not thought to be of sufficient interest to report.

The contracture may be so disabling that the function of the extremity affected may be practically lost. The mechanism of the production of the myositis should be thoroughly understood in order that prophylactic measures to prevent its development and operative procedures to limit its severity after it has commenced to develop may be instituted.

Ischemic myositis and gangrene are but different stages of the same process; the former may develop without the latter, and, on the other hand, a limited gangrene of the ends of the toes following a slowly developing stopping of the arterial circulation may develop without myositis. Ischemic myositis is the first stage of an acutely developing gangrene.

Various etiological factors have been emphasized from time to time as of first importance in the production of ischemic palsy. Especial emphasis has been placed upon constriction by circular casts or pressure by tightly applied splints. Scars which are found in some of the cases have been regarded as indicative of pressure. In some of these cases, however, the diagnosis of ischemic palsy hardly seems justified.

This is illustrated by a case observed by Brooks. His patient had had a fracture of the bones of the forearm which was treated by splints which were left on two weeks. When examined ten years later a marked contracture of the wrist in hyperextension with the thumb in a position of complete flexion and adduction across the palm was found. A large scar was present over the dorsal surface of the distal prominence of the radius and another deep scar where the end of the anterior splint rested in the palm. The patient gave a history of deep ulcerations being present when the splints were removed. There was marked atrophy of the extensor muscles of the forearm. An exploratory operation revealed that the extensor tendons were incorporated in a deep scar on the dorsum of the wrist. The bellies of the muscles were soft and showed normal nerve muscle reaction and no evidence of fibrosis. This contracture was due to cicatricial changes following a local deep pressure necrosis. There was no evidence of an ischemic myositis. It is quite probable that in some cases a diagnosis of ischemic myositis is not justified, and the scar is interpreted as the result of constriction, supposedly an etiological factor. Constriction by a tight cast or splint has been regarded by many surgeons as the principal, almost sole, cause of ischemic palsy occurring after fractures.

Leser, Kraske, Heidelberg and others have attempted to produce ischemic palsy experimentally by constriction. No one has succeeded however in producing a permanent, complete ischemic palsy in this way. The ichemic myositis produced in such experiments disappears after some weeks or months when the extremity is used. The contractures are not permanent as are many of the contractures observed in man. If an elastic bandage is allowed to remain too long gangrene develops. Vokmann believed that in the experiments in which a tight plaster of Paris cast was applied too few muscle fibers were involved; while in

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the cases in which an elastic bandage was used, all the arteries were closed, gangrene developing.

Ligature of large arteries is rarely followed by any marked degree of myositis. Brooks, as a result of his experiments, states that "muscular weakness associated with a certain stiffness which follows the occlusion of a large artery may be a phenomenon of ischemia. Under such conditions one would not expect a complete paralysis and there would be no immediate manifestations of inflammation or contracture. This muscular weakness would be very likely to improve with the development of a more adequate collateral circulation. It would always be exaggerated by exertion and improve with rest. It is not associated with a fibrous transformation of the muscles. A complete muscular paralysis of any portion of an extremity which follows the occlusion of an artery is evidence of an anemia of the tissues incompatible with viability and usually signifies impending gangrene. With the development of gangrene the skin will almost certainly become necrotic to a higher level than the muscles. The permanent occlusion of a large artery is not followed by an acute inflammatory disease. Anemia and inflammation are incompatible pathological processes. Any condition, therefore, which develops within twenty-four to forty-eight hours and which is characterized by heat, swelling, pain and a subsequent fibrosis cannot be the result of permanent occlusion of an artery."

Kurt Krause has demonstrated that a tight or constricting dressing is not always an etiological factor in the development of ischemic palsy, and his observations have been substantiated by a number of observers. Of the 56 cases of ischemic palsy collected and studied by Hildebrand, 24 were not treated with a cast. Denucé studied and collected 97 cases of ischemic palsy; a circular cast had been applied in 42, splints in 19. In 36 of the cases no dressing had been applied. Nerve palsies have been interpreted frequently as indicating that the dressing which was used was tight or constricting, but nerve involvement according to Volkmann is not a part of the clinical picture of ischemic palsy.

Fig. 1. Ischemic palsy. Antecubital fossa opened twenty-four hours after fracture, fourteen hours after beginning of cyanosis, swelling, pain and stiffness and fixation of fingers. Some myositis developed. Function of hand much improved by massage.

For the development of an ischemic myositis and infiltration, a sudden development of a venous stasis of a certain intensity is necessary. Ischemic contractures develop most frequently after certain fractures; those contractures which sometimes follow infections, freezing and burns are not being considered. This type of myositis and the subsequent contractures occur most frequently after fractures when the anatomical relations are such that the circulation through the principal vessels, especially the veins, may be interfered with by a hematoma or infiltration beneath a dense fascia. This type of lesion occurs most frequently after extension supracondylar of the humerus and fractures through the lower end of the femur. The relations in the antecubital and popliteal fossa are much the same. Ischemic palsy may be a complication of fractures of the bones of the forearm near the wrist, especially Colles' fracture. These are the fractures in which this disabling complication most frequently occurs.

Isolated ischemic contractures occur

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BALTIMORE

ISCHEMIC palsy or contracture is probably much more common than it is generally considered to be. It is certainly much more common than one would be led to believe from the number of cases appearing in the literature. In many instances the change is so slight that recovery occurs without any residue. In many instances the severer grades of palsy are not thought to be of sufficient interest to report.

The contracture may be so disabling that the function of the extremity affected may be practically lost. The mechanism of the production of the myositis should be thoroughly understood in order that prophylactic measures to prevent its development and operative procedures to limit its severity after it has commenced to develop may be instituted.

Ischemic myositis and gangrene are but different stages of the same process; the former may develop without the latter, and, on the other hand, a limited gangrene of the ends of the toes following a slowly developing stopping of the arterial circulation may develop without myositis. Ischemic myositis is the first stage of an acutely developing gangrene.

Various etiological factors have been emphasized from time to time as of first importance in the production of ischemic palsy. Especial emphasis has been placed upon constriction by circular casts or pressure by tightly applied splints. Scars which are found in some of the cases have been regarded as indicative of pressure. In some of these cases, however, the diagnosis of ischemic palsy hardly seems justified.

This is illustrated by a case observed by Brooks. His patient had had a fracture of the bones of the forearm which was treated by splints which were left on two weeks. When examined ten years later a marked contracture of the wrist in hyperextension with the thumb in a position of complete flexion and adduction across the palm was found. A large scar was present over the dorsal surface of the distal prominence of the radius and another deep scar where the end of the anterior splint rested in the palm. The patient gave a history of deep ulcerations being present when the splints were removed. There was marked atrophy of the extensor muscles of the forearm. An exploratory operation revealed that the extensor tendons were incorporated in a deep scar on the dorsum of the wrist. The bellies of the muscles were soft and showed normal nerve muscle reaction and no evidence of fibrosis. This contracture was due to cicatricial changes following a local deep pressure necrosis. There was no evidence of an ischemic myositis. It is quite probable that in some cases a diagnosis of ischemic myositis is not justified, and the scar is interpreted as the result of constriction, supposedly an etiological factor. Constriction by a tight cast or splint has been regarded by many surgeons as the principal, almost sole, cause of ischemic palsy occurring after fractures.

Leser, Kraske, Heidelberg and others have attempted to produce ischemic palsy experimentally by constriction. No one has succeeded however in producing a permanent, complete ischemic palsy in this way. The ichemic myositis produced in such experiments disappears after some weeks or months when the extremity is used. The contractures are not permanent as are many of the contractures observed in man. If an elastic bandage is allowed to remain too long gangrene develops. Vokmann believed that in the experiments in which a tight plaster of Paris cast was applied too few muscle fibers were involved; while in

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the cases in which an elastic bandage was used, all the arteries were closed, gangrene developing.

Ligature of large arteries is rarely followed by any marked degree of myositis. Brooks, as a result of his experiments, states that "muscular weakness associated with a certain stiffness which follows the occlusion of a large artery may be a phenomenon of ischemia. Under such conditions one would not expect a complete paralysis and there would be no immediate manifestations of inflammation or contracture. This muscular weakness would be very likely to improve with the development of a more adequate collateral circulation. It would always be exaggerated by exertion and improve with rest. It is not associated with a fibrous transformation of the muscles. A complete muscular paralysis of any portion of an extremity which follows the occlusion of an artery is evidence of an anemia of the tissues incompatible with viability and usually signifies impending gangrene. With the development of gangrene the skin will almost certainly become necrotic to a higher level than the muscles. The permanent occlusion of a large artery is not followed by an acute inflammatory disease. Anemia and inflammation are incompatible pathological processes. Any condition, therefore, which develops within twenty-four to forty-eight hours and which is characterized by heat, swelling, pain and a subsequent fibrosis cannot be the result of permanent occlusion of an artery."

Kurt Krause has demonstrated that a tight or constricting dressing is not always an etiological factor in the development of ischemic palsy, and his observations have been substantiated by a number of observers. Of the 56 cases of ischemic palsy collected and studied by Hildebrand, 24 were not treated with a cast. Denucé studied and collected 97 cases of ischemic palsy; a circular cast had been applied in 42, splints in 19. In 36 of the cases no dressing had been applied. Nerve palsies have been interpreted frequently as indicating that the dressing which was used was tight or constricting, but nerve involvement according to Volkmann is not a part of the clinical picture of ischemic palsy.

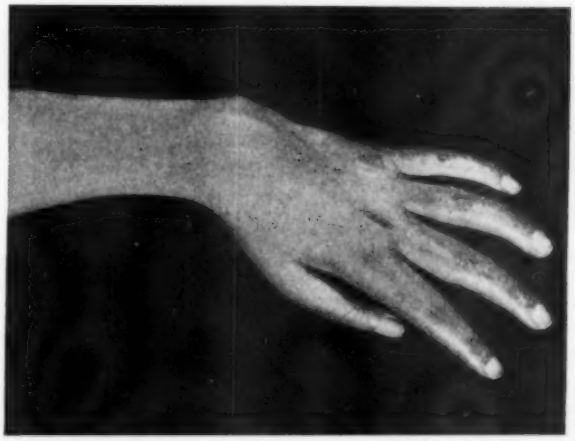

Fig. 1. Ischemic palsy. Antecubital fossa opened twenty-four hours after fracture, fourteen hours after beginning of cyanosis, swelling, pain and stiffness and fixation of fingers. Some myositis developed. Function of hand much improved by massage.

For the development of an ischemic myositis and infiltration, a sudden development of a venous stasis of a certain intensity is necessary. Ischemic contractures develop most frequently after certain fractures; those contractures which sometimes follow infections, freezing and burns are not being considered. This type of myositis and the subsequent contractures occur most frequently after fractures when the anatomical relations are such that the circulation through the principal vessels, especially the veins, may be interfered with by a hematoma or infiltration beneath a dense fascia. This type of lesion occurs most frequently after extension supracondylar of the humerus and fractures through the lower end of the femur. The relations in the antecubital and popliteal fossa are much the same. Ischemic palsy may be a complication of fractures of the bones of the forearm near the wrist, especially Colles' fracture. These are the fractures in which this disabling complication most frequently occurs.

Isolated ischemic contractures occur

almost only in children. They are, however, occasionally observed in older people, but the lesion which causes ischemic palsy

Fig. 2.

in the young is apt to cause gangrene in the adult. Ischemic palsy occurs in the young instead of gangrene because of the healthy conditions of the artery, the greater possi-

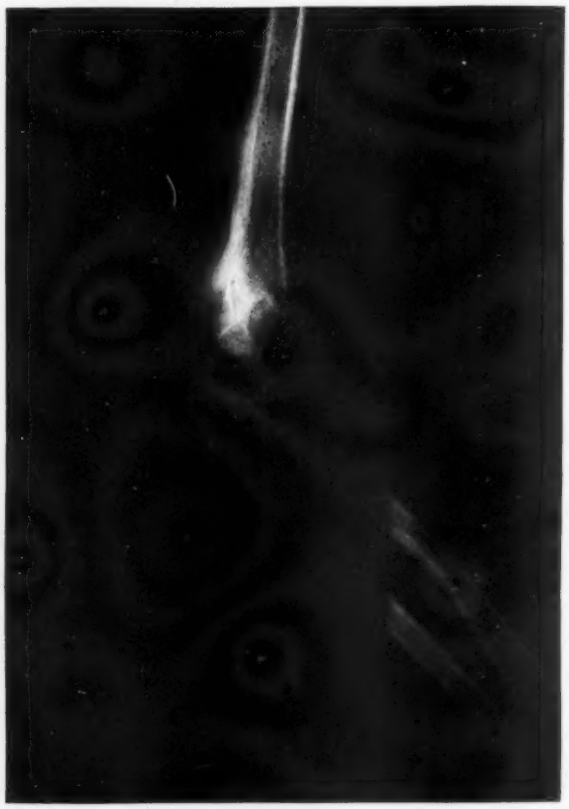

Fig. 3.

bilities for the development of a collateral circulation and good heart function.

There has been considerable discussion as to whether nerve injuries occur in ischemic palsy or not. No particular attention was paid to nerve involvement in the cases originally studied by Volkmann.

Fig. 4.

Figs. 2–4. Ischemic palsy, six months after fracture. Results of treatment of fracture indicated in roentgenograms. Contractures of mild type reacting readily to elastic traction.

Nerves may be involved, but not infrequently the injuries are direct. The extension fracture in the lower end of the humerus is the fracture after which ischemic palsy is most commonly observed. This is also the fracture in which median nerve injuries are not uncommon. The median nerve may be contused or torn by the lower end of the upper fragment in the extension fracture. Subsequently a median nerve so injured may be surrounded by scar, resulting in permanent damage unless a neurolysis or some appropriate operation is performed. Ischemic palsy is, however, primarily a muscle lesion, and the nerve lesions when associated with it are apt to be the result of a direct injury.

The mechanism of ischemic palsy should be understood in order that the symptoms

may be properly interpreted, and proper surgical procedures, prophylactic and active, instituted. Brooks, as a result of his experimental work, came to the conclusion that the classic picture of ischemic palsy could only be explained on the basis of acute venous obstruction. Clinical observations indicate the importance of venous obstruction as the etiological factor.

Induration of the antecubital fossa should be regarded as a danger signal. It indicates a hematoma or infiltration beneath the tense antecubital fascia, which seriously interferes with the venous return flow and the development of a collateral circulation. The importance of looking for this induration cannot be overemphasized, for its presence or absence may determine the procedure to be followed. The skin over the antecubital fossa is apt to be ecchymotic. It is usually tense and shiny. The radial pulse on the affected side may be normal, reduced in volume or absent. A careful examination should be made in all fractures of muscles, nerves and blood vessels. No fracture should be regarded simply as a fracture; but in all cases a careful examination should be made for associated injuries.

Severe spontaneous pain extending over the entire forearm in cases of supracondylar fracture is a symptom of importance and should demand attention. The pain is increased by pressure, and not infrequently an infiltration will be found in front of the wrist. The spontaneous pain is usually very severe, and, while it may not be so marked in some as in others, patients usually complain bitterly. The pain is felt especially about the antecubital fossa and along the veins. It is felt throughout the entire arm. The myositis with the infiltration has usually developed in greater part before the characteristic swelling and position of the fingers appear.

The muscles are swollen and indurated. The swelling and induration appear first in the bellies of the flexor group, then in the extensors, and then in the small muscles of the hand. The flexor muscles are first involved, probably, because of their nearness to the venous collecting trunks in the antecubital fossa. Swelling, cyanosis and oedema of the hand, especially on the dorsal surface, develop relatively slowly, for the myositic changes may be well developed when they appear. When the forearm is palpated, the indurated and swollen muscles will be felt. The fingers can be moved but little, if at all. When passive motion of the fingers is attempted, pain is felt. The fingers are usually flexed somewhat at the metacarpophalangeal and interphalangeal joints. They appear rigid and are swollen, seeming to project from a swollen palm.

The patient usually has a fever caused probably by the absorption of degenerated muscle. There may be a decided general reaction. Within two weeks, as a rule, the swelling subsides and the antecubital swelling and induration disappear; but the normal soft muscle belly is replaced by fibrous tissue, which, if the changes are extensive, may lead to the formation of hard fibrous masses or bands, sometimes of almost stony hardness, in place of the normal muscle bellies. The skin of the forearm, which during the active stage of the lesion was shiny, tense, cyanotic and swollen, and through which dilated veins might be seen, becomes thin, delicate and deprived of its subcutaneous fat. If an attempt is made to extend the hand the flexor tends to project as cords or bands, and the fingers are drawn into the palm of the hand.

The Position of the Hand and Fingers. The proximal phalanx is usually somewhat extended and the two distal phalanges are moderately or excessively flexed. Flexion of the two distal phalanges may be so marked that the nails are forced into the palm of the hand. The hand may be somewhat extended or in slight flexion. At times the thumb is not affected; while in other cases it is in rigid adduction. In some cases it is markedly flexed.

In most cases of ischemic palsy the changes are quite different from those

found in combined ulnar and median nerve palsy. In ischemic palsy when an attempt is made to extend the wrist, the fingers are forced into the palm. If an attempt is made to extend the fingers the hand is flexed. If one desires to extend the fingers the hand must first be flexed, a relative lengthening of the flexor tendons being attained in this way. This is one of the most certain tests of ischemic palsy, and there should be no doubt of the diagnosis for most of the cases are typical.

The following case indicates the onset of ischemic myositis:

This patient was a girl six years of age. This patient fell on the evening of Oct. 25, 1927 and injured her left arm. The injury proved to be a supracondylar fracture by extension. She was seen soon after the accident and it was then noted that her left forearm, wrist and hand were pale. At that time a radial pulse could not be felt. The fragments were manipulated and following this the radial pulse could be felt. Later under gas anesthesia a reduction under the fluoroscope was made. The reduction was easily made and the arm was then placed in flexion a little beyond a right angle. It was again noted that the radial pulse was not good, so the fragments were allowed to slip and once more the pulse became quite strong. Another attempt was made to reduce the fragments. After this reduction the pulse remained good and the color of the fingers quite normal. A posterior moulded splint was then applied with the forearm flexed at a little beyond 90°. Nothing was placed in the antecubital fossa in order to avoid pressure. The patient was watched for two and one-half hours. The circulation of the hand remained good and radial pulse appeared of normal size. The patient's parents were warned regarding the circulation and asked to return the next morning. The patient was brought back about eight o'clock the following morning, and at this time the hand was swollen, somewhat cyanotic and the fingers were partially flexed. The child could not move her fingers. The patient was admitted to the hospital.

The venous congestion, swelling and stiffness increased throughout the day. The patient suffered severe pain.

An operation was performed a little after seven o'clock on the day that the patient entered the hospital. After the patient was anesthetized a longitudinal incision was made from the lower part of the arm over the antecubital vessel into the forearm. When the skin was incised it separated widely because it was under tension. The incision was carried down through the fat and fascia over the antecubital fossa. Considerable blood had extravasated into the soft tissue, but no localized blood clot was found in the antecubital fossa. The incision was carried down between the muscles. The antecubital fascia was not sutured. The skin was close with some difficulty because of the tension. A posterior splint was applied, leaving the forearm in only very slight flexion. The dressings were applied loosely to avoid constriction. It was noted that at the end of the operation the rigidity and turgidity of the fingers were markedly improved.

A note made on October 29 stated that fingers remained of about the same color. Patient was unable to move them. Dressings were removed and some black silk sutures were removed. Several drops of serosanguineous material were removed. On November 23, 1927 the patient was discharged from the hospital with contractures of the fingers. Elastic traction, massage and baking have been carried on since, with marked improvement in the contracture and the use of the hand. I am quite certain that the incision of the antecubital fossa limited the extent of the myositis. The incision was made late, but the outcome is better than would have been expected at the stage of the development of the myositis when the incision was made.

The history of the following case would seem to indicate that we are dealing with a mild ischemic palsy in which no attempt was made to correct the ischemia even after it began to develop:

On July 25, 1928 this patient, aged five, fell from a fence and injured the left elbow. He was taken to a doctor who took the patient to the hospital. The next morning seven hours after the reduction, the arm being dressed in acute flexion, the hand and arm were considerably swollen. Nothing was done. The swelling gradually subsided. Blebs soon appeared on the fingers. When seen on January 26, 1929, the patient had a definite Volkmanns' contracture with induration of the flexor muscles. The contractures have been greatly

benefited by elastic traction and massage. The disability is greatly reduced.

The axiom that "an ounce of prevention is worth a pound of cure" can be no better applied in any way than to ischemic palsy. Easily prevented, the contractures are cured with difficulty. If in a supracondylar fracture, there is a marked displacement of fragments associated with injury to the soft parts and an infiltration and induration of the antecubital fossa, no cast or splint of any kind should be applied nor reduction by acute flexion attempted. While cast or acute flexion may not produce the myositis they are contributing factors to its development. An extension apparatus may be applied to prevent the over-riding of fragments, or the forearm may be allowed to remain in extension, no dressing being applied. With marked induration of the antecubital fossa no reduction should be made. The reduction can be made later. It should be remembered that what may be called a bad reduction may give good function, and poor reduction with good function is much to be preferred to perfect reduction with the disability of an ischemic palsy.

If the induration and swelling increases in the antecubital fossa, and cyanosis, weakness, oedema of the hand, immobility of the flexed fingers, and sensory disturbances appear, even if the painful subcubital infiltration is not great, operative interference must be considered. This consists of a longitudinal incision over the lower part of the arm extending through the antecubital fascia down into the fascia of the forearm. In some cases the tension will be so great that the skin cannot be sutured subsequently and it will have to be left open. Widely displaced fragments should be reduced when the operation is performed. Bardenheuer has used this procedure four times with marked success.

When the contracture has developed the prognosis depends entirely upon the amount of muscle that is left. If the contractile substance of the muscle has been replaced by fibrous tissue, no procedure will be of value. The disability is permanent, for there are no muscle fibers to function. Undoubtedly many mild cases of ischemic myositis recover completely. The resection of bones to produce a relative lengthening should be discarded. The results of tendon lengthening and transverse myotomy are disappointing. Gradual lengthening of muscles by elastic traction with the banjo splint, gentle massage, baking and other methods of physiotherapy give the best results providing that enough contractile substance remains, but in no case should passive motion be instituted which would be severe enough to cause hemorrhages in the muscle, for such hemorrhages would only be followed by the development of more fibrous tissue, increasing the contracture and disability.

Ischemic myositis develops after fracture even when no dressings have been applied. It develops as the result of an acute venous obstruction. Tight dressings or a constricting cast may determine the development of this myositis, if the conditions favoring it are already present. No attempt should be made at reduction of a supracondylar fracture when the antecubital fossa is infiltrated and indurated. If the cyanosis, swelling, and oedema of the hand associated with sensory disturbances, become more marked the antecubital fascia and fascia of the forearm should be incised to permit of the escape of the blood clot and infiltration in the antecubital fossa. The fragments may be adjusted at the same time. Elastic traction is the best method of treatment after the contracture is established. This may be combined with massage and other physiotherapy procedures.

SUSCEPTIBILITY TO CANCER*

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IT has been said that statistics can be made to tell anything, even the truth. The impressive statistics showing that cancer in the human species is increasing are at least open to question; reliable computations show that a greater number of people are living to reach middle or later age, at which time cancer is more common.

In countries that compile trustworthy statistics the incidence of cancer is approximately in the same ratio as to population and sex, but there is considerable divergence in the organs and tissues involved. About 30 per cent of the total deaths from cancer among women is due to cancer of the breast and genitalia. The genitalia of the male show a very low incidence of cancer. On the basis of cancer of the generative organs, therefore, one would expect the total incidence of cancer in men to be considerably lower than in women, but the percentage is approximately the same, because in men the organs common to both sexes, such as the stomach and the organs of the urinary system, are more frequently affected by cancer than in women, and this greater frequency is equal to the frequency with which the breast and uterus are the seat of cancer in women. The procreative organ (the testis) of the male is the primitive one from which the procreative organ (the ovary) of the female is derived, and the shorter life history of the female organs may perhaps make them less resistant to sources of chronic irritation than those of the male.

Cancer never develops in sound tissues. It has been assumed in the past that cancer is due to an external agency which enters into the human economy at the point of least resistance, such as a lesion caused by chronic irritation. New revelations would make it appear that cancer may be the result of agencies acting from within the body, due to biochemical dysfunction affecting the life history of embryonic cells. It is difficult to surmount the fact that when cancer has extended by metastasis to a new situation, it produces the histopathologic picture of the tissue in which it originated rather than that of the organ which becomes affected secondarily. If the disease were due to foreign invasion, it presumably would reproduce the type of cell of the newly invaded tissue rather than that of the primary seat of the tumor. In any event, it may be assumed that the agents which act on the cell to produce malignancy become an inseparable constituent of the cell, as metastasis in the human species takes place only by the transplantation of the malignant cell itself.

One factor of supreme importance which has not been sufficiently stressed is that individuals vary in their susceptibility to the cause or causes of cancer, whatever they may be. In no other way can we explain why 90 per cent of persons do not have cancerous disease, and why 10 per cent of them die from it. It is as logical to accept the hypothesis that the 90 per cent of persons have greater resistance to cancer than the 10 per cent, as to attempt to force an explanation of why only 10 per cent come in contact with hypothetic causative agents.

If the patient's susceptibility to the disease is the important factor in the development of cancer, the site of the growth would be determined by the tissue or organ subjected to the insult of a precancerous lesion, and the grade of malignancy and the metastatic possibilities by the susceptibilities of the body as a whole.

The most probable explanation would

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be that when sources of chronic irritation exist, the attempt of the tissues involved is to heal the breach of continuity by normal cells, but when the irritation continues for a long time, the tissues become unable to develop normal cells for the purpose, and cells that are more and more immature are rushed to the rescue; in the susceptible individual the cells continue an unlimited functionless division. Certain sources of chronic irritation seem to have greater potentiality to produce malignant disease than others, as unrefined tar, which in susceptible animals seems to possess greater than ordinary powers of precancerous irritation. And as much can be said for sunburn cancer of the skin, sometimes called Australian disease, because of its frequency in certain areas of that country. And again, the betel-nut cancers of the mouth in the Philippine Islands are examples of ready response to certain forms of chronic local irritation.

Prolonged heat appears to have an increased power of causing chronic local irritation; possibly taking too hot food and liquids may have to do with cancer of the esophagus and stomach.

The local response of the tissue subjected to chronic irritation apparently is influenced by general systemic factors which may either accelerate or delay the development of cancer. The existence of such general factors was pointed out by Murray[1] in experiments in which he subjected mice to successive courses of tar painting. Murray stated that when a number of mice are subjected to tar painting, cancer will develop in a few of them after four months; in a larger number about the sixth month, and in some mice cancer will develop only after a much longer period of tar painting, eight, ten, or even twelve months. In a few instances cancer does not develop. It seems, therefore, that there are variations in the resistance, or conversely, in the susceptibility of individual mice to cancer from tar painting. Presumably, an animal thus susceptible, if subjected to a second course of tarring after the first tar cancer has been removed by surgical procedures, would develop a second cancer in response to this form of chronic irritation within approximately the same length of time. Murray found the opposite to be true; cancer failed to develop in the experimental mice in response to a second course of tarring. It is not necessary that the first cancer should be a cancer of the skin or that it should have resulted from tar painting. Mice suffer frequently from spontaneous cancer of the mamma, and such mice are particularly susceptible to the disease. Murray found that when such mice, after surgical removal of the cancer, were given a course of tar painting, it failed to result in the development of cancer.

The work of Slye[2] on the grafting of cancer in mice is fairly conclusive in this respect. Slye found that by breeding strains of mice in which the disease developed most readily, the susceptibility of these strains could be increased enormously, so that mice would be born with the disease. By mating mice that were not so readily susceptible to cancer, strains could be developed in which cancer could not be produced or transferred.

The work of Gye and Barnard, if confirmed by further experimentation, will greatly advance our knowledge of immunity to cancer. Gye was able to develop from the fowl sarcoma of Rous two complementary filtrates: filtrate 1, a particulate body which he believed to be a living organism, and filtrate 2, a non-particulate body which he called the "specific factor." He believed that the first filtrate contained a foreign microörganism, and that the second was an activating fluid. If the two were injected together into fowls, cancer was produced, but if the first filtrate was injected without the second, which we

[1] Susceptibility to cancer. (Editorial.) *Lancet*, 215: 1137–1138, 1928.

[2] Slye, M. Some observations in the nature of cancer. Preliminary report. *Jour. Cancer Research*, 11: 135–151, 1927.

might call the soil-changer, cancer would not develop. When the infectivity of a previously infective Rous cancer fluid (first and second filtrates combined) was reduced, as with chloroform, until it could not be transplanted, if more of the second filtrate was then added, cancer transplantation would follow. Gye's second observation was that he could substitute for the first filtrate of the Rous tumor a virus obtained from true malignant new growths of the mouse, of the rat, and of man, and that this substituted virus together with the specific factor, the second filtrate, from the Rous tumor would produce sarcoma in the fowl. Other investigators have not been able fully to confirm Gye's work.

Equally relevant was the work of other experimenters who found that while the Rous virus could be transplanted readily into experimental animals, if the tumor which resulted from the transplanted virus was subjected to the roentgen ray, the transplantation did not take place or disappeared if the neoplasm had obtained a foothold, and if the tissues were exposed to the roentgen ray before the virus was used, the graft would not take. They learned that the same virus, however, remained potent in spite of exposure to the roentgen ray and would produce cancer in other animals. Apparently the effect of roentgen ray had been to develop resistance in the individual which prevented transplantation and yet did not destroy the virulence of the virus.

All there is to cancer is contained within the malignant cell, and this cell has remarkable resemblance to the rapidly growing embryonic cells of the chorionic villi (Langhans' cells). It should be noted that Langhans' cells have extremely large nuclei and undergo the most rapid division of any normal cells in the body, but the nucleolus and the cytoplasm of the cell have no peculiarity of structure. The stroma of a cancerous growth is the measure of nature's resistance. The greater the amount of stroma and the less the proportion of cells, the slower the growth. On the contrary, the greater the proportion of cells, the less their resemblance to the normal tissue involved, and the more rapid the growth.

Wilson, MacCarty and Broders have enlightened us greatly with regard to the histologic character of the cell in relation to malignancy.

Wilson was able, nearly twenty-five years ago, to develop an original polychrome methyl blue stain for frozen sections which gave good differential coloration of the various elements of the cell, thus making possible an immediate microscopic diagnosis. This method of examination of what might be called the "living" cell, because the examination takes place within two minutes after removal of the specimen at the operating table, tells the surgeon during the operation what the microscope sees in time to be of benefit to the patient, as contrasted with the celloidin or paraffin-fixed specimens with their artefacts, available at the end of four days to two weeks when it was too late to help the patient.

MacCarty called attention to the significant fact that the greater the proportion of the nucleus, and the less the differentiation of the cell cytoplasm the more rapid the growth of cells, as is normally seen in embryonic tissues. He went further, however, and showed that an excess of the nucleolar element within the nucleus is associated with the type of rapid growth and invasion which is clinically malignant.

Broders, in a careful clinicopathologic study of the relative amounts of cell differentiation in a tumor, pointed out that the more nearly the cancer cell approaches normal, the less the malignancy. In a long series of investigations he found that he could examine microscopic slides of cancerous tissue, and, without knowing anything of the history or the results of the operation, could classify the microscopic specimens into four clinical groups according to malignancy. An extensive follow-up study of patients operated on

for cancer has shown the accuracy of his prognostications. In the cases in Group 1, the disease, other things being equal, was essentially a benign process, with approximately 90 per cent of five-year cures from operation. In Group 2 there were 60 per cent of cures; in Group 3, 25 per cent, and in Group 4, 10 per cent. The results in Group 4 were so poor as to make serious surgical procedures of doubtful propriety, lest the immediate mortality be greater than the prospects of cure.

As an example, Broders' follow-up system showed that, contrary to general belief, the blacker a pigmented malignant growth, the less the malignancy, because the fully pigmented cells are more highly differentiated than the less pigmented cells. It is the function of the pigmented cell to produce pigment, and deep coloration is proof that this function is being performed. The value of these researches lies in their significance in showing that the greater the deviation in structure of the diseased cell from that of the normally functioning cell, the more malignant the process.

Bowing and Desjardins found from their experience with radium and roentgen ray that the more severe grades of cancer, Groups 3 and 4 of Broders' classification, may sometimes be made to take on the more favorable aspects of the cancers in Groups 1 and 2, with definite slowing of the process, so that sometimes such a case primarily inoperable may become operable. They point out that the sensitivity of the normal tissues of the part to roentgen ray and radium was the guide to the effect of these agents on malignant disease of the same tissues, and called attention especially to the extraordinary sensitivity of the lymphoid structures of the body. Desjardins found from experience that large malignant tumors of the lymphoid structures, so-called lymphosarcomas, would disappear so rapidly under roentgen-ray treatment as from that point alone to indicate the pathologic nature of the growth.

The assumption has always been that the more severe grades of cancer are due to a more potent cause. I hardly need point out that these newer revelations throw some doubt on so ready an explanation. It is equally if not more probable that the more severe forms of cancer and the development of cancer in certain tissues are due to increased susceptibility. A good general resistance with a moderate local lack of resistance may favor the development of cancer of Grades 1 and 2 of Broders' classification, whereas lowered general resistance and greater local lack of resistance in certain tissues would lead to cancers of Grades 3 and 4 and to a more rapid metastatic extension to tissues in various parts of the body.

In 1926, in an address on the cancer problem which I gave before the Congress of the American College of Surgeons in Montreal, I made the following statement:

"The foregoing studies logically lead to the idea of increasing individual resistance to the disease and its ultimate prevention. Science has been able to develop soil-changers in smallpox, diphtheria, and tetanus. Why not in cancer? Because of natural immunity to the disease, relatively only a small proportion of the total population is susceptible to scarlet fever. With the Dick test the degree of natural immunity of the individual to scarlet fever can be determined, and if it is not sufficient to protect from the disease, it can be increased to normal by serum. Why not in cancer? Perhaps the development of cancer as well as its degree of malignancy is attributable to the diminished activity of immunizing processes rather than to the nature of the activating agent."

Observations since that time have confirmed the belief that I then expressed.

FIFTEEN YEARS WITH RADIUM IN THE TREATMENT OF FIBROIDS, NON-MALIGNANT BLEEDING & DYSMENORRHEA*

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BROOKLYN

THE value of radium in the treatment of *cervical cancer* is now well established, for except in England and in some of the German clinics, massive or selective irradiation has replaced the radical operation for cancer of the cervix, even in group 1 cases. This unanimity of opinion is based on five-year and seven-year follow-up records, which in many instances are nearly 100 per cent complete. However, in the treatment of non-malignant bleedings, fibromyomata, intrinsic dysmenorrhea and subinvolution of the uterus, the effect of irradiation is less certain, for while treatment by radium in a large proportion of properly selected cases has been followed by some miraculous cures, others having what has seemed to be a similar pathology have not yielded to the effect of the rays, though similar dosage and filtration have been employed.

The records from which this presentation is made cover fifteen years of radium therapy and give a very clear picture of our failures as well as our successes. Furthermore, they reveal the reasons for these failures, which for the most part have been errors of selection. This brings up the question; can selection be accurate, and what are the other factors which militate against success? The results herein reported have been obtained with 200 mg. of the radium element; emanations or the radium pack have not been employed; roentgen irradiation of the ovaries has occasionally supplemented the use of intrauterine capsules in large tumors. Our follow-up system, which is detailed, has given us the opportunity to see the results, modify and limit our indications and change the form of application.

Two factors determine the growth and development in all fibroid tumors, i.e. the location of the nodule and its relation to the uterine circulation; these, likewise, determine the life history and termination of every fibromyomatous growth. All fibroids, however, do not act the same when their blood supply is cut down or cut off. Furthermore, the blood supply is not the same in all portions of the tumor. This, in part, explains some of the variations and disappointments in our results, for any degree of edema affects the value of irradiation. With these facts accepted, we have undertaken this study in order that we may attempt to draw a few clean-cut deductions which may guide us in the future selection of cases for radium therapy.

Before it is possible to determine upon a plan of treatment in any uterine myoma, we must first appreciate:

1. How fibroid tumors develop and grow as well as how they live.
2. What associate conditions change the rate of their growth.
3. How and why they produce symptoms.
4. Finally; what pathological changes these tumor masses may undergo and to what dangers and complications these changes may lead. That all types of myomatous tumors are not amenable to radium or roentgen-ray treatment is generally conceded; but, likewise, all fibroid tumors do not require surgery and may need no treatment at all.

The fibroid tumor is the most common form of uterine neoplasm, and while histologically it is benign, it possesses great potentiality for harm by its growth, the attendant bleeding, pressure symptoms, circulatory and malignant changes. The last are evidenced by Fraenkel who found in a serial study of 1860 tumors removed

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by operation, sarcomatous changes in 46. About half of these occurred in interstitial myomata and presented no clinical evidence of malignant change. The remaining half originated in the endometrium and the diagnosis was made by curettage and examination of the biopsy findings. Hence, it is evident that routine diagnostic curettage will not detect every sarcomatous growth; however, bleeding was a *constant symptom* in all of the sarcomatous tumors which originated in or near the endometrium.

The histogenesis of uterine fibroids is not definitely known. It is probable, however, that they develop from congenital rests or fetal misplacements of fibrous tissue in or about the wall of the blood vessels which course within the uterine muscle. When first recognized, these congenital rests appear as solid nodes which seem to be due to a proliferation of the muscular and connective-tissue elements in the myometrium around the different rest centers. They are usually found in the uterine body as small nodules, *in, but not of the muscle,* incapsulated and discreet. Our observations lead us to the belief that the hyperpituitary type of women who begins her menstrual life with an anteverted, anteflexed uterus with a relatively large uterine body, is prone to develop myomata. We have followed many women of this type for over twenty years and have watched them grow fibroids. Again, the subthyroid and subpituitary type with the anteflexed retroposited uterus and other symptoms of hypoplasia, the subjects of intrinsic dysmenorrhea, who are frequently sterile, often develop fibroids. On the other hand, women of perfect endocrinal balance seldom grow this type of tumor. Fibroids always produce a relative degree of sterility, either by imparing fertility or by favoring the early termination of conception by the production of abortion. Conversely we find that the uterus of the barren woman with endocrinal imbalance who menstruates thirteen times a year, is more prone to develop fibroids than the uterus which becomes frequently pregnant and is alternately passing through periods of hypertrophy and involution. In the last analysis, however, the sterility is not due to the fact that the uterus contains a fibroid or fibroids, but rather to *their location and their size.*

The growth and development of fibroid tumors as has already been stated depend: (1) on their relation to the uterine blood supply; (2) upon their location in the muscular walls. The great mass of the arterial and venous blood supply is found in the outer third of the uterine wall, and, as the pelvic and uterine vessels have no valves the blood is propelled through the sinuses of the uterine wall by muscular contraction. The basal endometrium and inner third of the uterine wall have a relatively poor supply, for the uterine arteries and veins which ascend toward the fundus on the lateral walls of the uterus give off the accurate vessels, veins and arteries which course anteriorly and posteriorly, while these in turn break up into the intermuscular branches which reach the basal endometrium as arterioles, actually terminating in the venous radicals from which the venous return begins. This paucity of endometrial circulation is one factor in the terminal necrosis which takes place in the overstretched endometrium covering submucous and polypoid tumors, and explains the metrorrhagia which is common in this form of growth.

The second physiological phenomena which determines the life, location and development of the fibroid is the constant intermittent contraction of the uterus, for every tumor mass is evolved in the direction of least resistance, carrying with it its capsule and circulation. These two factors are basic in determining the life and development of every tumor. It is only the intramural growth which is surrounded on all sides by an equal amount of uterine muscle that grows slowly and remains within the confines of the uterine wall. It is this type of tumor which atrophies at the menopause; likewise, it is

this type of tumor which is at some period of its growth amenable to radium and roentgen-ray therapy.

Menstrual bleeding is common in interstitial and sessile submucous growths, both of which increase the area of endometrial response, for any tumor which is extruded toward the uterine cavity or grows into it increases the area of endometrial surface, blocks the venous return and thus increases the duration and amount of the menstrual flow. *As long as the continuity of the endometrium is maintained, we have menstrual hemorrhage,* but as *soon as tissue necrosis occurs* in the overstretched atrophic endometrium, *intermenstrual bleeding* becomes a factor. It is, therefore, apparent that we must accurately determine the location and the relation of the tumor to the endometrial surface before radium or roentgen rays are selected for the cure of uterine bleeding.

Wh le it is admitted that diagnostic curettage should precede the introduction of radium in every case of endometrial bleeding, experience has taught us that the curette is not without danger; for in sessile submucous growths penetration of the capsule affords an avenue for infection, while in endometrial hypertrophy when curetting has been done, we have linear strips of retained endometrium between which are grooves opening lymphatics for bacterial invasion. Clinically, we have noted that when radium is introduced immediately following diagnostic curettage, the tissue reaction is much greater than when an interval of ten days or two weeks is allowed to elapse between taking the biopsy specimen and the introduction of the radium. Furthermore, it has been noted that there is less parametrial reaction when the radium is placed in the fundus above the internal os and kept there than when the capsules have had a cervical lie.

RADIUM IN MYOMATA

Radium will control the hemorrhage of uterine myomata and in a large number of cases will reduce the size of the tumor, provided the tumor is intramural or submucous, *and not pedunculated.* Nevertheless, operation is still the procedure of choice for most myomata, for the indications for radium are limited and it has certain definite *disadvantages* such as:

First: While it controls bleeding and in the majority of cases reduces the size of the tumor, nodules outside of the uterus may be left without a blood supply and consequently are more likely to give trouble.

Second: Malignant complications already in the tumor may be overlooked for it has been shown that sarcoma is found in serial section in about 6 per cent of pedunculated submucous tumors. Consequently, we can lay down the dictum that radium is never permissible in submucous growths, unless a diagnostic curettage is possible, for while remarkable results have been shown following radiation of cervical cancer, body carcinoma is less likely to be permanently affected by the rays.

Third: About 54 per cent of all fibroids are complicated by some form of tubo-ovarian disease, consequently many of these complicating intrapelvic lesions are missed, and while the tumor is shrunk, and the hemorrhage controlled, the associated lesions keep up the patient's illness.

Fourth: Radiation when applied in sufficient dosage to check hemorrhage and shrink the tumor will seriously impair the reproductive functions in young women, and therefore should not be used as a procedure of choice in this class of cases.

Fifth: One group of the symptoms in fibroids which require treatment are those due to tumor pressure; here the effect of radium is too slow to relieve the effects which intraligamentous growths produce on the ureters and in blood vessels.

Sixth: The immediate effect of radium is the production of edema and the excitation of inflammatory reaction; hence, in the presence of old inflammatory adnexal lesions, this reaction becomes more marked.

Finally: Radiation will increase the necrosis in tumors which are already

necrotic, and by added acidosis increases the toxemia of the patient.

Against these disadvantages radium has certain definite advantages in the treatment of fibroid tumors, particularly if proper selection is made. These *advantages* are:

First: There is no operative mortality. There is no general anesthetic. There are few postoperative complications, and there is prompt control of uterine bleeding.

Second: Should radium fail, operation is always possible.

Third: The menopausal symptoms are not so marked.

Fourth: In intramural tumors we cannot only expect absolute cessation of the hemorrhage, but shrinking in the tumor in over 65 per cent of the growths.

Fifth: Radium is the procedure of choice in myomata complicated by heart disease, diabetes, chronic nephritis and in pronounced anemia for the temporary arrest of hemorrhage.

We have confined radiation in fibroids to those tumors which are not larger than a three-months' pregnancy, where the growth is definitely intramural and there are no subperitoneal nodules of any considerable size; and those submucous tumors which after careful examination under anesthesia are shown to be sessile. In all, we have treated 206 of these growths by radiation. In the same period over 700 fibroids have been removed by operation. These patients have had from 1800 to 2000 mg. hours of irradiation The radium element has been applied directly to the interior of the uterus in capsules in tandem, the alpha and beta rays have been excluded by proper filters using brass, aluminum, rubber and platinum of ½ to 1 mm. thickness. I have the follow-up records of all these cases and only 6 have needed subsequent operation. In these 6, all submucous tumors, the bleeding recurred and on operation it was found that the tumors had undergone a marked edema and necrosis. In 200 cases the bleeding ceased and has never recurred after the first menstruation, which was more profuse in a number of instances than some of the previous bleedings; this, in turn, was followed by a serosanguinous discharge which persisted for several weeks. In 136 of these tumors the growth has shrunken to less than half of the original size, and in 70 it has entirely disappeared.

SUBINVOLUTION, FIBROSIS UTERI, UTERINE INSUFFICIENCY

A large proportion of the patients who come to us for the relief of bleeding fall within the class of subinvolution. Fibrosis uteri is what is termed by some as uterine insufficiency, which vague term is used to designate a uterine condition in which there is severe menorrhagia without gross pathology to explain the cause of the abnormal bleeding. The uteri which we have removed for this condition, in the days when vaginal hysterectomy was popular, have shown a more or less constant pathology in the relative increase in the connective tissue over muscular tissue in the uterine wall. This tissue disproportion is characteristic of subinvolution or the uterus of repeated pregnancies and a common finding of the woman approaching the menopause. In this class my associates and I have applied radium therapy for the relief of bleeding in 260 women; we have never failed to check the hemorrhage temporarily, and in the majority of instances have controlled it for all time. Of these uteri 234 have atrophied and after a period of several months the characteristic symptoms of the menopause have appeared. Many of the cases in this group have been complicated by prolapse of the uterus in which cystocele was the predominating lesion. We have subsequently operated upon these women, interposing the atrophied uterus under the bladder with cure of the descensus. Clinical experience has taught us that it is good surgery to correct backward displacement before radium is applied; better drainage is thus secured.

MYOPATHIC HEMORRHAGES IN YOUNG GIRLS

Bleeding in this group is frequently excessive and is almost always due to endometrial hyperplasia; in fact the menorrhagia or metrorrhagia may be so excessive as to produce extreme secondary anemia. Some yield to the administration of pituitary extract, the regulation of the pelvic colon and cecum, intramuscular injections of sera and blood transfusion. When, however, this profuse bleeding is prolonged, the endometrium is usually hypertrophied and edematous and the uterus may be larger and softer; the cervix is soft with a velvety feel and the os is likely to be open with a halo of erosion about it. Not infrequently one or the other ovary shows palpable cystic enlargement. The blood studies of these cases have shown that the coagulation time and bleeding time have been within normal counts and the platelet count is similar to that found in secondary anemia due to bleeding. It was formerly common to curette these patients after all forms of internal medication had been tried and failed. Curettage is usually followed by temporary amenorrhea which lasts for a month or two; this, in turn, is followed by menorrhagia and metrorrhagia. This same case treated by radium for from 200 to 300 mg. hours, with the radium properly filtered with glass, silver, brass and rubber to cut out all of the alpha and beta rays, will establish normal menstruation after one seance. Only once have we had occasion to repeat the exposure. In this class 31 cases were treated. The average dosage was 250 mg. hours and but one application was given in 30 of this series. Our follow-up results have shown that the quantity of the menstruation as well as the duration was regulated in every instance except the one patient who required two intrauterine applications. The last of these was followed by an amenorrhea which lasted for one year when the menses were spontaneously established and have since recurred regularly. Six of these girls are now married and have become pregnant; three have been delivered of normal living children, a fact which answers some of the criticisms which have been made of using radium in young girls.

INTRINSIC DYSMENORRHEA

For years dysmenorrhea was classified as obstructive, congestive and neuralgic. Later other authorities gave it a uterine and ovarian origin, and still others attributed this distressing symptom to psychoneurosis. As we have come to have a better understanding of the physiological changes which make up the menstrual cycle, our conception of this disease has been materially revised.

Primary dysmenorrhea (intrinsic or essential) is usually part of the clinical picture of general hypoplasia. There is always a lesion, elusive as this may be, either in the endometrium or in the uterine wall. It is only by careful study of the sequence of symptoms that a conclusion can be arrived at. These uterine dysmenorrheas of the developmental type are commonly found in the anteflexed, retroposited uterus with defective cervical invagination and in the acute forward or backward flexions with fibroid rests. All parametrial or adnexal lesions must be excluded by examination under anesthesia. Cases of the first type have yielded to gradual dilatation of the cervix with Hegar sounds, and mild irradiation, while those with retrodeviations have had painless menstruation after the displacement has been corrected, the cervix dilated and radium applied. After the cervical canal is thoroughly dilated 50 mg. of radium properly filtered are introduced high in the uterine cavity and allowed to remain there for a period of four hours, a dosage of 200 mg. hours. This amount of irradiation does not stop menstruation, but for some unexplained reason, relieves the pain at succeeding menstrual periods. Thirty-six of such cases have been treated in our private clinic with absolute relief of their menstrual pain; 9 have subse-

quently become pregnant and 6 have been delivered of living children with no physical defects. Many of these women were invalided for two weeks out of every month and had previously been treated by dilatation, discission, electrolosis, the static current, diathermy, etc.; and 4 had been accustomed to taking large quantities of morphine for the relief of their pain.

CLIMACTERIC HEMORRHAGE (MENOPAUSAL BLEEDING)

Bleeding at the menopause should always be looked upon with suspicion, for the healthy woman with normal pelvic organs passes through this period without severe general or local disturbance.

Menorrhagia at the menopause is generally believed to be due to a deranged internal secretion which is a result of failing ovarian activity; likewise, it is explained that the hypertension, flushes, attacks of profuse perspiration, nervousness, irritability and depression are a result of the decreased ovarian secretion which allows an endocrine imbalance and invites increased adrenal function. Nevertheless, menorrhagia at this period demands investigation, for while endometrial hypoplasia is the common finding, the transition from endometrial hypoplasia to benign adenoma and then to adenoma malignum is an accepted possibility. In this series there were 3 such cases, women who in *two years time* passed through these pathological grades; fortunately they were under constant observation and their lives were saved by a timely hysterectomy. In others the uterine content is lacking, the endometrium is scant and atrophic, a condition found in 19 of this group. Women presenting histories of metrorrhagia should always be curetted, and the biopsy specimen examined microscopically before any plan of treatment is instituted.

We have been surprised since adopting the plan of routine curettage before introducing radium or employing the roentgen ray, to note how many of these bleedings are due to small submucous myomata, or fibroid polypi. Thirty-three fall within this class. Cervical polyp was the pathology which caused the metrorrhagia that brought 20 of these women to the clinic. Three had retained decidual tissue, dating back many months; while in 18, the microscopic findings were adenoma; in 7 of these the bleeding recurred and the uterus was extirpated. In all 96 cases were treated in which the anatomic findings fell among the foregoing, and which because of the time of occurrence we have classed as menopausal bleedings. Ninety-four have been followed: in 87 the uterus is atrophied and there is no discharge; in 7 the bleeding recurred and the uterus was removed.

CERVICAL STRICTURE

This lesion is caused by placing the radium too low in the uterine canal or by the capsule being forced down toward the internal os by uterine contraction. It results in a constriction at the internal os, complete or relative, which interferes with uterine drainage and produces hematometra or pyometra, most frequently the latter. The symptom complex suggesting this complication consists of uterine colic simulating labor pains with sorensss and tenderness in both lower quadrants and over the hypogastrium, which is relieved by an intermittent discharge of blood or pus, or if this fortunate outcome fails to occur the uterine pain continues and on bimanual examination will reveal an enlarged fluctuant tumor in the location of the uterus. The blood sedimentation time is always low, though there may be no elevation in temperature or in the leucocyte count. Twelve of our cases have returned with this complaint. The treatment has been gradual dilation of the cervix with Hegar's sounds. This treatment should be repeated in two months, and where after thorough dilatation the purulent discharge persists, the uterine cavity should be obliterated with a chloride of zinc pack.

CONCLUSIONS

As our experience with radium has

increased our indications have become more and more limited and we believe that the follow-up study of this series justifies us in making the following deductions and suggesting the following contraindications:

1. Accuracy of diagnosis is essential and if there is doubt as to the diagnosis, operation is preferable to irradiation.

2. Highly neurotic or over-sexed individuals, or those with an unbalanced nervous system, should not be treated with radium, as irradiation produces atrophy of the vagina and cervix as well as atrophy of the ovaries, and is apt to accentuate all symptoms.

3. The occurrence of other intraabdominal lesions requiring surgery makes it wiser to operate on many pelvic tumors than to employ radium therapy.

4. Very rapid growth of a pelvic tumor suggests malignancy of the uterus or ovary, and complete extirpation is preferable to irradiation.

5. Degenerating pelvic tumors should be removed by operation.

6. Pressure symptoms from large fibroid growths of the uterus are most quickly relieved by hysterectomy as tumor shrinkage from irradiation is variable and uncertain and may never occur.

7. Pelvic inflammatory lesions may become activated by radium and cause peritonitis and death; hence, in the presence of these lesions operation is indicated.

8. Large pelvic tumors, pedunculated subserous fibroids and large submucous growths require hysterectomy, particularly so, if there is pressure on the bowel, ureter, bladder, or when metrorrhagia is the prominent symptom.

9. Radium has proved its usefulness in the treatment of menorrhagia in young girls and in intractable cases of dysmenorrhea without gross extrauterine lesion. The amount of radiation should never exceed 300 mg. hours. The treatment may be repeated if necessary.

10. For myomata in young girls or in child-bearing women under thirty-five years of age, myomectomy should be selected; while in multinodular growths with extensive involvement of the myometrium, subtotal hysterectomy with the retention of an ovary and tube should be the procedure of choice.

11. Extremely anemic patients or women in which the cachexia is out of proportion to the blood picture are bad radium risks. Operation gives the better results, but all such operations should be preceded by blood transfusions.

12. In cases with malformation, faulty position, or cervical tumors where uterine drainage is impaired, radium should not be used.

13. Parametrial exudative processes or adnexitis contraindicates the use of radium.

14. Finally, careless and indiscriminate use may produce far reaching damage. Where radium is indicated for benign gynecological conditions, the least amount of radium that will control the situation is the ideal.

THE CLINICAL COURSE OF SUBACUTE YELLOW ATROPHY AS OBSERVED IN TWO PROVEN CASES*

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FOLLOWING the first clinical description of acute yellow atrophy by Bright in 1836 and Rokitansky's studies of the pathology of the disease in 1842, cases have been recognized and autopsies reported. The studies of Marchand,[1] Meder,[2] Stroebe,[3] Barbacci,[4] and MacCallum[5] have added to the morbid anatomy of these lesions, but the several varieties of the acute degenerations of the liver and the etiological factors causing the lesions are still poorly understood. The fact that following certain of these acute degenerations areas of regenerated liver tissue are to be found in the scarred remains of the shrunken liver has been recognized by pathologists, and in a number of instances patients have been operated upon with the diagnosis of obstructive jaundice or acute or chronic cholecystitis with immediate or subsequent autopsy studies. The studies of the clinical course following such operations are very few and for this reason the 2 cases to be described are considered of sufficient interest to warrant their report. One of these patients has been studied for five months, the other for six years, after the onset of subacute yellow atrophy. Umber's[6] case, operated upon in 1919, is the only other instance of a follow-up report that the writer has found in the literature.

MacCallum[5] studied a case of a boy who had recovered from a severe illness "which may have been acute yellow atrophy" and six months later died of an acute infection. The liver was greatly reduced in size but contained a tumor-like mass in the right lobe, composed of dark green nodules like swollen liver lobules. Throughout the general liver substance every liver cell had been destroyed, the frame work had remained intact with the bile ducts and blood vessels, and from every bile duct sprouts were growing into the old frame work although nowhere producing definite liver cells. In the right lobe a portion of liver tissue had evidently been left intact, and this had become the tumor-like mass by the symmetrical enlargement of each remaining lobule. The mass which was finally the size of an orange must have been smaller at first and yet it sustained life and prevented any serious symptoms of hepatic insufficiency.

In the discussion of these pathological studies MacCallum concludes: "Where well-differentiated liver cells still persist, the new liver tissue is very simply produced by their mere multiplication by division and the less highly differentiated gall ducts take no part in the process but remain quiescent in their subordinate position as conductors of the secretion of the liver cells. Where, however, all the liver cells have been destroyed the epithelial cells of the gall ducts take upon themselves the more complicated process of production of liver tissue by first rapidly multiplying and then becoming differentiated, adopting the characteristics of the liver cells."

Pool and Bancroft[7] reported 2 cases with biopsy and autopsy findings showing the later stages of subacute yellow atrophy. One patient, a woman of twenty-one, had had symptoms of the disease for three and one-half to four months before operation, but preceded for a period of three years with symptoms suggesting chronic cholecystitis. She died twelve days after operation in coma.

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The second case, a woman of sixty-four, had had a history of four months of digestive disturbances and asthenia. Five weeks before operation she began to have painless jaundice, followed in twelve days with severe right upper quadrant pain, obstinate constipation, constant nausea, and pronounced weakness with fainting spells. This patient did well for three days after the exploratory operation, but then became drowsy and died in coma. In both these patients the liver, at time of operation, was small with a sharp edge, the surface presenting circumscribed nodules of regenerated liver tissue elevated from the firm, degenerated liver tissue.

Umber[6] reported the first case of subacute yellow atrophy, explored during the convalescence from the disease, surviving operation and with a follow-up report of ten months. His patient, a girl of eighteen, developed painless jaundice with enlarged tender liver which later decreased in size under observation. She developed severe attacks of what was thought to be biliary colic, and an exploratory operation was performed two months after the onset of her first symptoms by Oberarzt Dr. Neupert. The liver was markedly decreased in size, but of the normal consistency, large and small nodules of regenerated liver tissue standing out above the surface of the connective tissue remains of degenerated liver. Gall bladder and ducts were not abnormal. The liver edge was sharp and above the rib margin.

Case 1. M. M. Unit Record #76301. Admitted to the Presbyterian Hospital on November 14, 1928. This is the first admission of a thirty-six-year-old Jewish housewife who came to the hospital complaining of jaundice of five weeks' duration.

Family History. The mother had had gallstones.

Past History. No accounts of severe illnesses, but the patient's general health had always been considered rather poor. She had suffered since puberty with indigestion, constipation, heart burn, distention after meals, and poor appetite. For a great many years she had complained of gaseous eructations after meals, associated with nausea and vomiting. These periods of indigestion were particularly severe during the menstrual period. Her menses began at fourteen and were always profuse. The patient had been married for fifteen years without pregnancies. A bilateral salpingectomy for pyosalpinx had been performed eleven years previously at another hospital.

Present Illness. About nine months before admission she had a severe attack of indigestion and became quite dizzy, complaining of great weakness. At this time she had severe midepigastric, cramp-like pain radiating in both directions across the epigastrium into the back and interscapular region. At the time she was said to have a trace of bile in the urine. Following this period she began to lose weight and strength. Five weeks before admission she had another attack somewhat similar, but less severe than the one nine months previously. Some time later jaundice was observed and traces of blood were noted in her vomitus. Stools were noted to be a light color and jaundice persisted increasingly. There were no further attacks of severe pain, but epigastric discomfort and pain between the shoulders persisted and jaundice remained the same, although her stools and vomitus contained bile.

Physical Examination. Temperature 99.4° F; pulse 78; respirations 20; blood pressure 115/75. The patient is a fairly well-developed and well-nourished woman showing a fairly deep jaundice of an orange hue. The significant findings were tenderness over the liver area, a spleen palpable 2 cm. below the costal margin, liver not palpable. Laboratory Findings: R.B.C. 4,600,000; Hgb. 75 per cent; W.B.C. 8,000; Polys. 78 per cent. The urine showed a trace of bile. Serum bilirubin 20 mg./100 c.c. Direct van den Bergh reaction positive. Blood Wassermann reaction negative. Both bleeding and clotting time were prolonged. The red cell fragility test was normal. The gastric test meal showed no free hydrochloric acid. The stool contained bile and was colored. The duodenal tube showed abundant bile. Amylase was diminished in the pancreatic juice. The liver function test with bromsulphthalein showed a marked retention of the dye.

The patient was on the Medical Wards for a period of seventeen days, running an afebrile course, but continued to have pain and tenderness over the liver, continued jaundice and

"amine" breath. It was thought impossible to rule out an obstructive jaundice with cholecystitis, but the writer, called in consultation, made the following note:

"I have maintained from the first time I saw this patient that the diagnosis is acute liver degeneration because of

1. The jaundice, beginning without pain, increasing without remissions.

2. Brown-colored stools with plenty of bile in stool and vomitus.

3. A liver decreasing in size; if it were an obstructive jaundice of this grade it should be enlarged up and down.

4. She has the deep orange tinted jaundice seen in acute degenerative lesions. A jaundice as deep as this I have never seen with bile showing in stools and vomitus where it was due to stone.

5. She has the amine breath which we have noted in almost all these acute degenerative lesions.

6. She has the nausea and anorexia of these cases.

Of course I am not certain enough of this diagnosis to rule out common-duct obstruction and have frankly discussed the uncertainty of an exploratory operation with the patient who accepts the hazard."

The *operation* was performed on December 2nd under local anesthesia with the following findings: The gall bladder, ducts and pancreas appeared normal. The liver was markedly diminished in size, had a somewhat uneven, irregular surface, although there was not noted the large nodules of elevated liver tissue, representing regenerated liver. The liver was somewhat firmer in consistency than normal and had a sharp liver edge in the parts examined. A section was removed which was reported as showing no remains of normal liver cells with areas of dense connective tissue containing remains of bile duct epithelium. Diagnosis: subacute yellow atrophy. (Fig. 1.)

This patient made a fairly good recovery after the operation, although her nausea and vomiting continued as did her jaundice. About a month after operation her jaundice, however, had markedly decreased. At this time, however she developed ascites for which paracentesis has been done three times. The patient left the hospital for two or three weeks, but returned because of increasing fluid and has been in the Medical Wards for the past five weeks. The jaundice has almost cleared and her ascites has diminished so that she has not had any paracentesis for the past month.

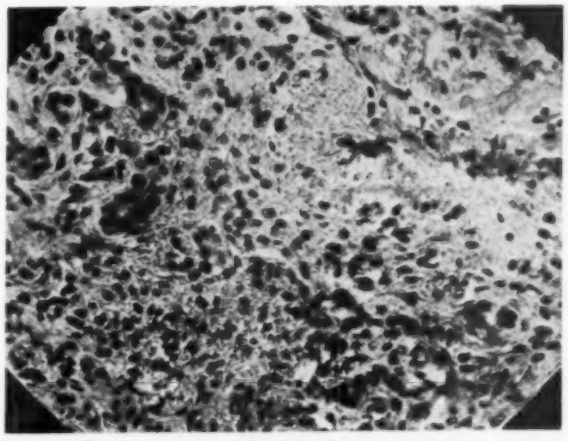

Fig. 1. S. P. 39217. M. M. Section of liver tissue removed four months after onset of subacute yellow atrophy showing no remains of liver cells, but some proliferation of bile ducts.

Case 11. B. H. Unit Record #56101. This patient, a thirty-three-year-old, unmarried, American stenographer, has been in the Presbyterian Hospital on five occasions. The essential features of her medical history and course are as follows:

She was well until the latter part of 1922 except for a severe attack of diphtheria when she was thirteen years of age. For about four months prior to her first admission in January, 1923 she had a poor appetite and lost 17 lbs. during the last month of that period. At the beginning of that month she had a bad cold which persisted. For about ten days before admission she was nauseated continuously and had a "heavy feeling in the stomach." She vomited occasionally and became very constipated. A week before entering the manifestations of jaundice appeared—dark urine and yellow skin, but no clay-colored stools. Examination at that time was essentially negative except for the jaundice and malaise with tenderness along the right costal margin which persisted and at times radiated around to the scapular region with a tender trapezius muscle. Catarrhal jaundice was suspected and also cholecystitis with "pancreatic asthenia," but other observations were made at that time which threw doubt upon these diagnoses: 1. The fact that she had felt poorly for four months before admission.

2. The presence of "amine" breath.

3. The rather striking rib tenderness.

4. The gastric intolerance apparently out of proportion to her general condition.

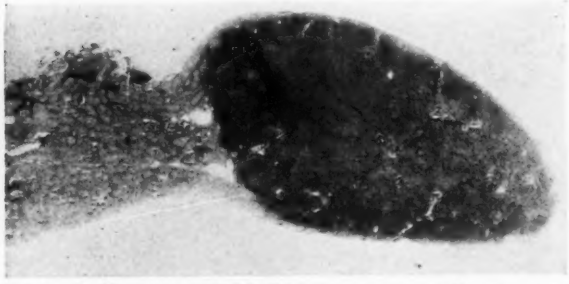

Fig. 2. S. P. 30051. B. H. Biopsy one year after onset of subacute yellow atrophy. Low power of a nodule of regenerated liver in an area of fibrotic tissue.

5. The fact that her stools were brown and contained bile in spite of the fact that her jaundice increased. She came in at the time when there was an epidemic of infectious jaundice.

She remained in the hospital two months. Her blood picture was normal, Wassermann reaction was negative, and she ran an afebrile course. Vomiting was a striking symptom and mental depression became a marked feature when the jaundice deepened. At times her mental apathy progressed almost to a coma. All the symptoms seemed to become accentuated during menstruation. The liver was not observed to increase but rather to decrease in size during this time. The tetrachlorphthalein test for liver function showed a distinctly abnormal retention of dye. The jaundice gradually faded, the attendant symptoms cleared up and she was allowed home.

She was admitted again just about a year later chiefly because of the persistence of pain in the right upper quadrant, along the costal margin without jaundice. Blood chemistry figures were normal but the liver function test still showed a marked dye retention. Exploration was thought to be justified and was done. The entire liver was found to be deformed as the result of marked changes in its structure: bands of pinkish colored connective tissue divided the liver surface into various shaped oval and circular islands of normal appearing liver tissue. Because of the shrinking of these bands the normal islands of liver tissue were pushed out, giving a disc or lenticular-like appearance to these islands. The gall bladder and ducts were essentially negative. The pathological report was as follows:

Gross Specimen. The specimen is a piece of liver edge 2 cm. long and with a disk-shaped nodule projecting from it measuring 1.2 cm.

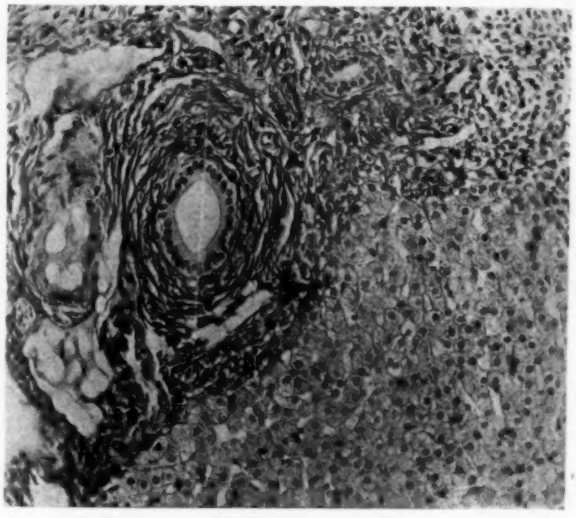

Fig. 3. S. P. 30051. B. H. Biopsy taken one year after onset of subacute yellow atrophy. Section shows area of regenerated liver cells in an area of dense fibrosis.

in diameter and 5 mm. in thickness. On cut section the liver is of the usual color while the projecting nodule is much lighter, a pale brownish yellow, and seems much firmer in consistency.

Microscopic Examination. Sections were fixed in formalin and Zenker solution and stained with H & E, Van Gieson, Mallory's connective tissue stains and Scharlach R. They show the nodule which projects from the margin of the liver edge to be composed of masses of relatively normal-appearing liver cells. The architecture of the lobules seems to be well preserved and there is no definite fibrosis in this spot. The adjoining tissue is made up very largely of strands of connective tissue, enclosing many large and small bile ducts and blood vessels. Scattered through the connective tissue are a few isolated liver cells which seem relatively normal except for their isolation. There seems to be no fatty infiltration of the liver cells. There seems to be no demonstrable proliferation of bile capillaries in either part. The picture seems to fit into a lesion which has, at some previous time, destroyed a large part of the liver substance. The large nodule of liver tissue probably represents a compensatory hypertrophy following the destruction.

Diagnosis. Acute yellow atrophy of liver. (Figs. 2, 3.)

The recovery from operation was uneventful surgically, but subsequently she complained of the old right upper quadrant pain. At intervals she had attacks characterized by (1) anorexia, nausea and vomiting, (2) pain and tenderness over the right lobe of the liver, (3) very obstinate constipation, (4) extremely foul breath with coated tongue, and (5) great mental depression and apathy. At times these attacks were so severe that she was thought to be going into cholemia. Then again there would be quite a dramatic remission and she would be apparently normal. She was discharged improved in three months.

Her third and fourth hospital admissions were the results of quite different episodes. She continued, at varying intervals, to have symptoms more or less as already described for about three and one-half years after operation, when she began to vomit blood in rather large amounts. She was admitted and her treatment on this occasion was largely to combat the effects produced by hemorrhage. It was successful and she returned to work. Nine months later a somewhat similar episode occurred without warning and she entered the hospital in shock from loss of blood. The most likely explanation appeared to be hemorrhage from esophageal varices. At the end of her stay she was slowly recovering from the loss of blood.

The patient was readmitted to the hospital on March 1, 1929 and was operated upon under ethylene anesthesia, at which time an omentopexy with the inclusion of the mesentery of the large intestine in the posterior rectus sheath was done because of a small atrophic omentum. The findings at the second operation in the liver were as follows:

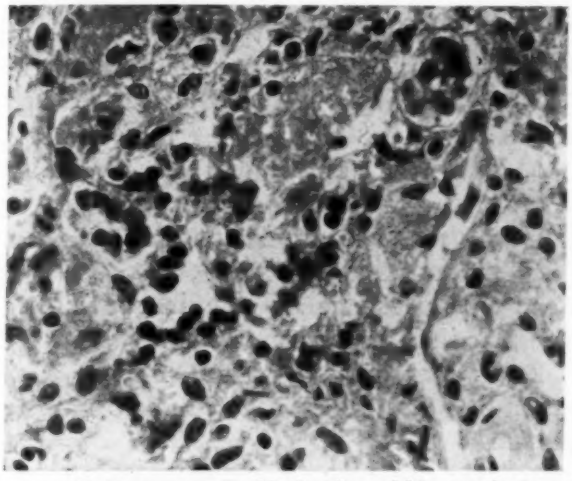

Fig. 4. S. P. 39970B. B. H. Section of biopsy six years after onset of subacute yellow atrophy. Complete disappearance of all liver cells. Remains of bile duct.

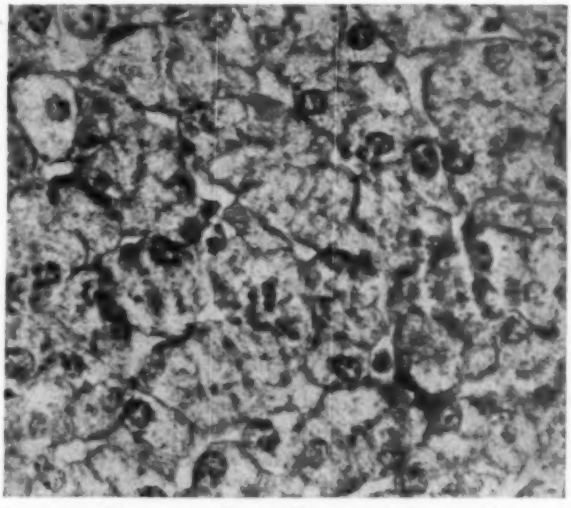

Fig. 5. S. P. 39970A. B. H. Section of biopsy six years after onset of subacute yellow atrophy. High power of regenerated liver cells. Vacuolated appearance of cells is probably due to glycogen.

There was the same remarkable picture in the liver of a regeneration following acute yellow atrophy, i.e. knob-like projections of normal appearing liver tissue, separated by yellowish pink bands of connective tissue, giving the appearance of islands of liver tissue rising above a sea of dense scar tissue. There was no free fluid in the peritoneum. The vessels in the mesentery and round ligament were moderately engorged. The omentum, unfortunately, was short and scanty which made it necessary to include a part of the gastrocolic omentum in the anterior abdominal wall. The gall bladder appeared normal and was not attached to the anterior abdominal wall.

Sections of liver tissue removed from the left lobe of the liver at this time were reported as follows:

Gross Specimen. Specimen consists of a small piece of liver tissue which is already in Zencker solution, so that the gross landmarks are difficult to interpret.

Microscopic Examination. On section, there are two distinct portions of the section. One consists of what is apparently regenerated liver tissue. The cells are somewhat variable in size and the cytoplasm is pale and distinctly granu-

lar, but the nuclei stain well and it is probable that the granular appearance of the cytoplasm presents some phase in the functional activity of the cells. The architecture of this portion is not like that of normal liver tissue. The lobulation is not distinct and there is a much greater distance between the portal areas than is usual. There is no distention of the canaliculi with bile. The other portion of the section shows an extremely fibrotic area dotted with round cells in which the remains of liver cells and of ducts may be seen. For the most part, the duct structures are old, but in one or two areas, ducts may be seen in which the lumen is not patent and where the cells are parallel to the long axis. Presumably these represent regenerated ducts. This is an exceptional finding.

Diagnosis. Regeneration of liver (following subacute yellow atrophy). (Figs. 4, 5.)

The patient made a very uneventful recovery, having far less postoperative nausea and vomiting than after the first operation. At the end of three weeks she was walking and had recovered her strength and vigor to an astonishing degree, and she was sent to a convalescent hospital where she, at the present time, is reported to be doing very well and is to return to her work in another ten days.

It is to be noted from the findings in the cases of Pool and Bancroft, in Umber's case, and in the 2 cases here described that the pathology in the living is quite different from that seen on the autopsy table several hours after death. In the living these livers are firm in consistency and have not the wrinkled, flabby, soft feel that is described in the autopsy reports. The nodules of regenerated liver tissue project abruptly above the surface of the degenerated liver, and the liver edge is sharp as noted in all of the operations.

These patients represent undoubtedly a subacute rather than an acute form of so-called yellow atrophy inasmuch as they did not go into the rapid cholemia and progressively fatal symptoms of the severe acute yellow atrophy. They may perhaps better be called cases of acute liver degeneration, but they represent a certain group of cases that offer difficult differential diagnoses from the cases of gallstone or pancreatic common-duct obstruction in which surgery is indicated and effective. On the other hand there are certain differential points to be noted on careful observations in the history and physical and illustrated in both these cases, in Pool's and Bancroft's cases and in Umber's case, which make a fairly certain differential diagnosis:

1. The lack of typical biliary colic.
2. Severe anorexia, nausea and vomiting, obstinate constipation preceding a painless jaundice.
3. The presence of bile in stools and vomitus in jaundiced patients.
4. A deep orange tinted, rather than greenish, jaundice with bile-containing stools.
5. The presence of a peculiar pungent, fetid breath, termed by Loeb, of the Presbyterian Clinic, an "amine" breath and referred to by Umber as "fetor hepaticus."
6. The presence of a small liver, which may have been observed to be decreasing in size. In obstructive jaundice of any duration the liver increases in size.

Of course there will always arise the question as to whether gallstones or pancreatitis can be ruled out, and the onus of not ruling this out by an exploratory operation will have to be borne by the consulting surgeon called in by the medical advisor of the patient. The writer cannot see any great harm in proving the diagnosis by means of a small incision under local anesthesia, and in the cases reported the course of the disease has not been appreciably altered by such a simple procedure.

The subsequent clinical course of these patients is well illustrated in both of the cases here reported. With so much scarring of the liver portal obstruction is the logical late result. In the first case ascites has occurred and at the end of five months persists notwithstanding paracenteses. In the other patient the establishment of a collateral circulation has resulted in esophageal varices with two very severe gastric hemorrhages. In fact in both of these

patients an omentopexy to provide a possible shunting of portal blood became indicated and was carried out in the case of B. H. five years after the first operation and six years after the onset of her liver degeneration. The patient M. M. is considering the advisability of the operation.

This brings up the point of the advisability of doing an omentopexy if a severely scarred liver with areas of regeneration is found at the time of the exploratory celiotomy. The writer would be in favor of such a primary procedure if he should again encounter a similar case.

The study of these 2 cases has impressed us with the unfavorable prognosis in these cases of subacute yellow atrophy. Because of the liver damage remissions of liver dysfunction are almost certain to occur as well as portal obstruction. In the case of B. H. there have been several striking recurrences in the past six years of the syndrome of anorexia, nausea and vomiting, obstinate constipation, pain and tenderness over the liver, "amine" breath and great mental depression. The amazing feature of this case is the fact that she has made such remarkable recoveries from these remissions with what appears to be a return to astonishingly good states of health and working ability. For periods of eight to twenty-four months she has recovered and returned to her work at full efficiency. This as well as the remarkable picture which her liver has shown on the two occasions of her operations points to that marvelous power of regeneration in the liver and its unequalled factor of safety.

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LIPOMA OF THE STOMACH

REPORT OF A CASE*

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BENIGN growths of the stomach are not common as compared to other tumors of that organ. Eusterman and Senty have shown that less than 0.5 per cent of gastric neoplasms are benign. Balfour and Henderson reviewed all of the cases of benign tumors of the stomach that had been encountered at operation in The Mayo Clinic up to 1926; 58 cases were studied. The majority of these tumors were fibromas, myomas and fibro-adenomatous polyps. There were no lipomas in the series. Since this review there has been 1 case of gastric lipoma that has come to operation.

Lipoma is one of the most uncommon tumors of the stomach. In a thorough review of the literature we were able to find only 14 cases. Stetten, in 1909, reviewed the literature and compiled 77 cases of lipoma of the gastrointestinal tract. Of this number only 3 were in the stomach. The largest number were situated in the ileum and colon. He stated: "Lower down in the gastrointestinal tract the larger number of lipomas are found."

Ehrlich compiled from the literature 52 cases of gastrointestinal lipoma. Three were in the stomach, 6 in the duodenum, 6 in the jejunum, 9 in the ileum, 24 in the large bowel and 4 were indeterminate. His data corresponded closely to those of Stetten.

Borrman stated: "While lipomas of the intestine are not infrequent, in the stomach they are not often observed."

Virchow, in 1863, was the first to report a case of lipoma of the stomach. This was found at necropsy in a male; the age of the patient was not stated. The tumor was about 1 cm. in diameter, unilobular, situated on the posterior wall of the stomach, near the pylorus, and had arisen in the submucosa.

Murray, in 1888, reported a case in which he had found a lipoma of the stomach at necropsy. The patient was a man aged sixty-four years. There were no clinical symptoms that were referable to the growth. The tumor was situated in the submucosa, on the posterior wall of the stomach close to the lesser curvature and 5 cm. from the pylorus. The structure of the tumor was typical of the class to which it belonged.

Tilger found 2 lipomas of the stomach in 3500 necropsies. In both cases the neoplasm was situated in the submucosa near the pylorus and occurred in elderly persons. The exact age and the sex were not stated. The tumors were about 3 cm. in diameter.

Fischer, in 1905, cited a case, that of a woman aged thirty-seven years, in which he had encountered a fibrolipoma of the stomach in an operation for epigastric lesion. For one month prior to the operation the patient had had attacks of generalized dull abdominal pain occurring only during the day. Three days prior to exploration she had an attack characterized by severe pain of the kind described, localizing in the epigastrium. Vomiting was not associated; rest in bed and dieting were without benefit. At operation a hard red tumor was found on the anterior wall of the stomach, encroaching on the lesser curvature. It was about 3 cm. in diameter and projected somewhat from the wall of the stomach. The serosal covering was red and showed a number of dilated blood vessels. The tumor seemed to involve the entire thickness of the wall of the stomach. The growth with the adjacent inflamed

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area was excised by removing a v-shaped segment from the anterior and posterior wall. The mucous membrane over the neoplasm was normal. The growth seemed to have originated from the muscular coat. The pathologic report was fibrolipoma with inflammatory changes and hemorrhage into its substance.

Bénaky reported a case, that of a man aged sixty-five years, in which there was found at necropsy a lipoma of the stomach 6 by 3.5 by 2 cm. in size and weighing 38 gm. It was oblong, flattened and slightly umbilicated, being attached to the posterior wall 1 cm. from the pyloric opening and completely obstructing it. The site of origin was in the submucosa. It was well encapsulated, easily enucleated and adherent only to the mucosa at the level of its central depression. Its color and consistence were characteristic of lipoma.

Hellström found at necropsy a submucous lipoma of the stomach in a man aged seventy-seven years. It was a flattened growth about 1 cm. in diameter and situated 7.8 cm. from the pylorus. There were no symptoms referable to the growth.

Nahmmacher described a gastric lipoma which was an incidental finding at necropsy in a woman aged sixty-five years who died of pneumonia. The growth was cylindrical, measured 8 by 3.5 by 3 cm., and was attached to the posterior wall very near the pylorus. The mucous membrane covering it was smooth except for a depression, 3 by 4 cm., over its proximal pole. Microscopically the tumor arose from the submucosa, the distal pole bordering directly on the pylorus but not producing obstruction to the latter. On section the tumor was composed of fatty tissue of a smooth golden-yellow color. The surface interposed between mucosa and musculature. The surrounding mucosa of the stomach did not show change.

Eliason and Wright found a gastric lipoma at necropsy in a man aged fifty-two years who died of pneumonia. It was situated in the submucosa of the fundus of the stomach. There were no symptoms referable to the growth.

Bianchi, in 1926, reported a lipoma of the stomach found at necropsy in a woman aged fifty-seven years. There was a history of dyspepsia and vomiting of a year's duration. The finding of a cirrhotic liver was probably the explanation of gastric symptoms rather than the lipoma. The tumor was situated in the submucosa near the pylorus. There was no ulceration of the mucosa. The structure of the growth was typical of a lipoma.

Spitzmüller presented a case of a man aged sixty-nine years with a history of intermittent diarrhea of one and a half years' duration and the passage of mucus and blood in the stools. Six months previous to operation an epigastric tumor was elicited. It was about 8 cm. in diameter, cylindrical, smooth, and moved with respiration. A roentgenogram showed an intragastric tumor of the stomach, probably carcinoma. Exploration revealed a dilated and hypertrophied stomach which contained a tumor, 20 by 27 cm., cylindrical, soft, elastic, yellow, grossly lobulated and sharply defined. It was attached to the posterior wall half way between the lesser and greater curvatures. The serosa over the tumor was normal; the mucosa was atrophied with two areas of ulceration. The adjacent mucosa was normal.

REPORT OF A CASE

The patient, a man aged fifty-nine years, came to the clinic in October, 1927, on account of stomach trouble. Five years previously he had had an initial attack manifested by a sense of epigastric emptiness and a gnawing sensation in the stomach. This was associated with the passage of several tarry stools. He was also weak, dyspneic and had palpitation on exertion. Following this he had four somewhat similar attacks. The fourth and most pronounced one occurred in December, 1926. Because of a severe hemorrhage from the bowel a transfusion was given at that time. He was confined to bed for six weeks. He recovered completely and felt well until the fifth and last attack which

occurred in August, 1927, at which time he was in bed for three weeks.

The general examination was essentially

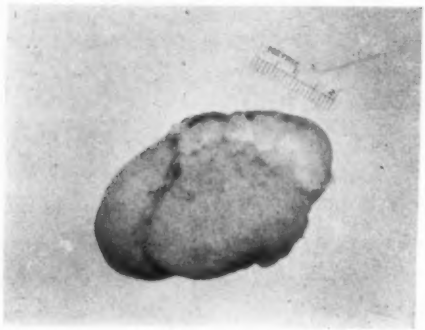

Fig. 1. Tumor after removal, showing attached gastric mucosa.

negative except for moderate tenderness in the epigastrium. Urinalysis was negative. The hemoglobin was 70 per cent. Erythrocytes numbered 3,940,000. The gastric analysis showed the total acidity 68 per cent and free hydrochloric acid 50 per cent. The Wassermann reaction on the blood was negative. The roentgenologist reported a lesion on the posterior wall of the middle of the stomach, suspicious of early malignancy. A preoperative diagnosis of ulcer or benign tumor of the stomach was made.

At exploration a lipoma of the stomach was found. It was situated on the anterior wall about midway between the greater and lesser curvatures and 10 cm. from the pylorus. Gastrotomy was done and the part of the anterior wall containing the growth was excised. Other tumors or ulcers could not be demonstrated. The pylorus was open and the duodenum seemed to be normal. Exploration of the small bowel and colon was negative. The specimen, after removal, was an ovoid, smooth and well-encapsulated tumor, measuring 5.5 by 3.5 by 2.3 cm. in its greatest dimensions (Fig. 1). It was yellow, fat-like and slightly lobular. On one side there was an area of gastric mucosa 3 by 2.5 cm. In the center of this attached mucous membrane was an umbilicated area of erosion. Microscopically the chief constituent of the tumor was fat (Fig. 2). Apparently the tumor arose from the submucosa and involved it chiefly. There was a superficial erosion of the mucosa near the center of the attached membrane. The gastric lining at this point was reduced to about a third of its thickness as compared to more distant areas. There was no sign of inflammatory reaction in the adjacent tissues.

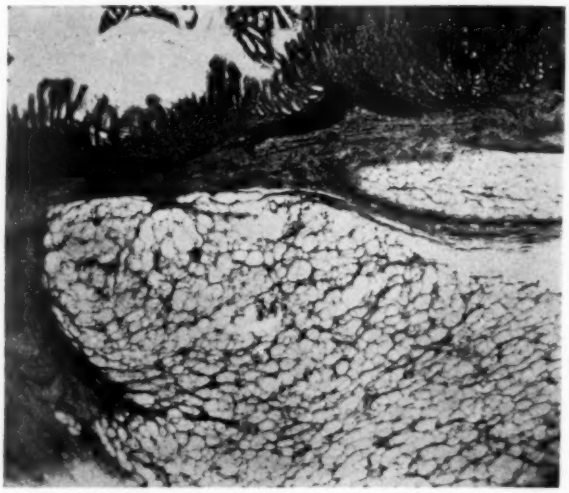

Fig. 2. Section of tumor, shown in Figure 1, taken through the eroded area; fatty tumor may be seen under the muscularis mucosae.

COMMENT

Although lipomas are by no means rare in the submucous cellular tissue of the intestinal canal, they are rarely encountered in the stomach. As a rule gastric lipomas do not cause symptoms unless complicated by inflammatory changes, bleeding, ulceration or pyloric obstruction. The greater number of lipomas of the stomach that have been reported have been found at necropsy and have not given symptoms referable to the tumors.

Of the 14 cases compiled from the literature all but 2 were found at necropsy; of this number only 1 lipoma gave rise to symptoms. (See Table 1.) This was in Bénaky's case. The tumor was wedged in the pyloric opening, completely obstructing it. In the 2 cases in which the tumor was found at operation there were symptoms that well might be attributed to the lesion in the stomach. In only 8 cases were the age and sex stated, 5 males, and 3 females, between the ages of thirty-seven and seventy-seven (average sixty and three-fourths years). In 12 cases the tumor arose from the submucosa, in 1 case from the

TABLE I

DATA ON CASES REPORTED IN THE LITERATURE

Author	Date	Age	Sex	Found at necropsy	Size of lipoma	Site of lipoma						Symptoms
						Layer	At pylorus	Body	Fundus	Curvature	Wall	
Virchow	1863	..	M	+	About 1 by 1 cm.	Submucous	+	...	...	.....	Posterior	
Murray	1888	64	M	+	.....	Submucous	+	...	...	Lesser	Posterior	
Tilger	....	...	...	+	About 3 by 3 cm.	Submucous	+					
Tilger	....	...	...	+	About 3 by 3 cm.	Submucous	+					
Fenwick & Fenwick	1902	...	...	+	5 by 5.6 cm.	Submucous						
Fenwick & Fenwick	1902	...	...	+	About 2 by 2 cm.	Submucous						
Fischer	1905	37	F	*	About 3 by 3 cm.	Mucous	.....	+?	...	Lesser	Anterior	Abdominal pain; vomiting
Bénaky	1905	65	M	+	6 by 3.5 by 2 cm. (weight 38 gm.)	Submucous	.....	...	...	.....	Posterior	Pyloric obstruction
Hellström	1906	77	M	+	About 1 by 1 cm.	Submucous	7 cm†					
Nahmmacher	....	65	F	+	8 by 3.5 by 3 cm.	Submucous	+	...	...	.....	Posterior	
Eliason and Wright	1925	52	M	+	.....	Submucous	.....	...	+			
Bianchi	1926	57	F	+	.....	.....	+					
Spitzmüller	1926	69	M	*	20 by 27 cm.	Submucous	.....	...	...	Between lesser and greater	Posterior	Diarrhea; mucus and blood in stools
Borrman	1926	...	...	+	About 3 by 3 cm.	Subserous	.....	+	...	Greater	Anterior	

* Found at operation.
† From pylorus.

subserosal layer, and in 1 case from the muscularis. In the cases in which the site of the lipoma was given, it was near the pylorus in 8 (1 being wedged in the pyloric opening), in the body of the stomach in 1 case and in the fundus in 1. Two were near the lesser curvature, 1 was near the greater curvature, and 1 was half way between the two curvatures. Five were on the posterior wall and 2 were on the anterior wall. The size of the tumor varied from about 1 cm. in diameter to 20 by 27 cm. Only 2 of the lesions were pedunculated. In 2 there was associated inflammation of the adjacent submucosa. In another case there was a defect of the mucosa covering the lipoma.

Lipomas of the stomach have the same characteristics as lipomas in general. They grow slowly and expansively, are lobulated, and are partially surrounded by the connective tissue in which they have developed. They vary from about 0.5 cm. in diameter to a weight of several grams; the color usually is that of normal fat.

The case herein reported is of unusual interest; for in spite of the fact that the tumor was small it gave rise to repeated and alarming gastric hemorrhages. The growth was well encapsulated and associated inflammatory reaction was not present. The mucosa over the growth was normal except for a small area which was closely adherent to the tumor and umbilicated. No doubt this was in the area which had eroded, with the resultant hemorrhages. This eroding process had repeated itself with each hemorrhage and healing had taken place in the interim.

SUMMARY

Gastric lipomas are rare. Most of those that have been reported were found at necropsy. The usual site of growth is in the submucous layer of the stomach. As a rule they are symptomless unless complicated by inflammatory changes, ulceration, pyloric obstruction or bleeding. They may give rise to alarming hemorrhages, occult bleeding with secondary anemia, or pyloric obstruction.

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MALIGNANT TUMORS OF THE BLADDER & PROSTATE*

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BALTIMORE, MD.

IN tumors of the bladder, it is often difficult to say positively whether or not the case is malignant; in fact, we may consider that many cases of apparently benign papillomata of the bladder are potentially malignant, as we have all seen, in the days before fulguration was introduced, cases in which apparently simple papillomata eventually became malignant. Where a tumor is frankly infiltrating, little difficulty of diagnosis occurs, but where the tumor is of the papillary type, considerable difficulty may be experienced, and even when a section is removed, the outer portions of the tumor may show little evidence of malignancy. The pedicle and base are the most important parts to study microscopically, and these may be difficult to excise with the small cystoscopic forceps which are usually employed. It has been our practice for a number of years to use the cystoscopic rongeur, with which much larger pieces of tissue are obtainable, and where a positive diagnosis is very desirable, one should attempt to obtain a portion of tumor near the bladder wall to exclude malignancy in that region.

The operative indications depend much on the location of the tumor. Where one is certain that the disease is malignant, and particularly where it is infiltrating, or a definite carcinoma of the bladder, there can be no doubt, in our opinion, as to the great value of resection. This should be as thorough as possible, and if the tumor is situated in a portion of bladder covered by peritoneum, we think this should be excised with all the coats of the bladder wall. In such cases it is necessary to go into the abdomen, but we have recently shown that it is quite possible to excise the peritoneum with a large area of bladder wall without doing a previous laparotomy. One may penetrate through all coats, including the peritoneum, from an intravesical exposure, and without danger of injuring the intestines, and no difficulty is experienced in closing first the peritoneum and then other coats of the bladder through the intravesical wound. If the tumor is located on the anterior, lateral or posterior walls of the bladder, and especially if at the vertex, it is our opinion that in invasive carcinoma of the bladder, radical resection should be carried out. Unfortunately, the large majority of vesical tumors are located in the region of the trigone or closely adjacent to the ureteral or urethral orifices, and surgical extirpation becomes not only more difficult but far harder to make radical, owing to the inability to do as wide resections as in the upper portions of the bladder.

The results in infiltrating carcinoma of the base of the bladder are far from satisfactory. The immediate mortality is fairly high, and the percentage of recurrence is very large. In some cases the necessity of transplanting the ureter has brought on serious complications. After trying various methods of operative technique for carcinomata of the base, we have come to rely largely on the implantation of radium through a suprapubic wound, after excision of the intravesically projecting portion of the tumor by means of cautery. A study of 72 cases, in which suprapubic resection of the bladder was carried out, shows that 33 are already dead from recurrence, and in 3 there has been recurrence, though these patients are still alive at the end of a year. Four patients are dead from other causes, in some of which there may have

* Read before the New York Branch of the American Urological Association, Oct. 24, 1928.

been recurrence. Six cases have been lost sight of. Twenty-two patients are either free from symptoms, or are well on cystoscopic examination. Two have shown recurrences on cystoscopic examination, but these recurrences have disappeared by endovesical treatment, fulguration and radium. Twelve patients are apparently well after an interval of four years since operation. Most of these are cases of tumor of the vertex, anterior, lateral, or upper posterior wall of the bladder, and it is doubtful whether we have a single case of a tumor in the trigonal region cured by resection alone.

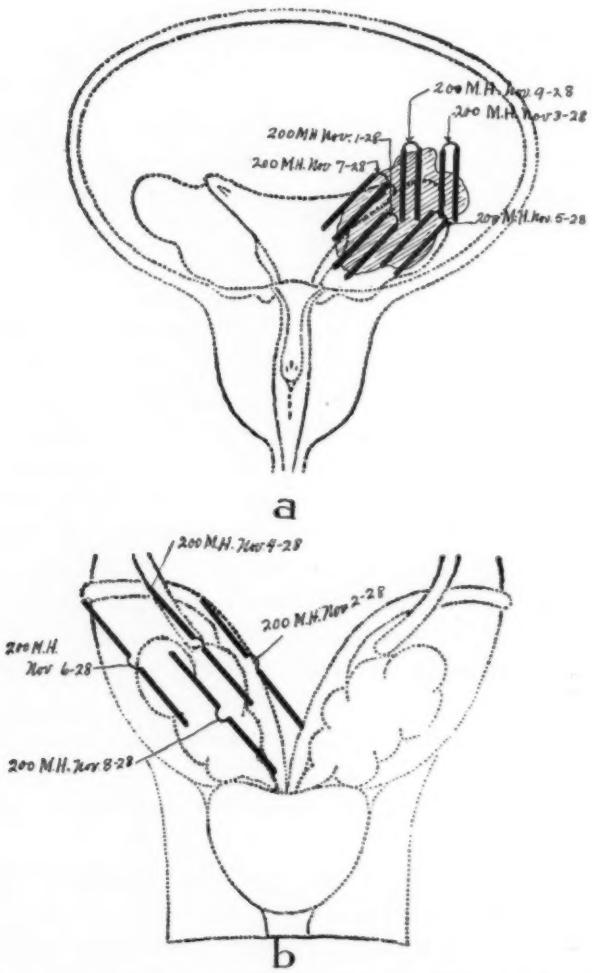

Fig. 1. Charting of radium applications: *a*, intravesically, with Young's cytoscopic applicator; *b*, by rectum, with Young's simple rectal applicator.

In the treatment of papillary tumors of the bladder, we have found high frequency electrical applications (fulguration or electrocoagulation) of the greatest value. Where the disease is benign and not very extensive, a very rapid destruction and complete disappearance of intravesical papillary tumors is secured. Even when benign, a larger papilloma can be made to disappear very much more rapidly by the applications of radium in addition to fulguration; in fact, it is our practice to apply radium with my cystoscopic applicator in practically all cases of vesical papillomata, even where small or benign. Not only is the disappearance of the tumor greatly facilitated, but we consider it very important to have this application of radium to the pedicle and base of the tumor, as it is here that one fears eventual malignancy, and the use of radium may be looked upon as a preventive.

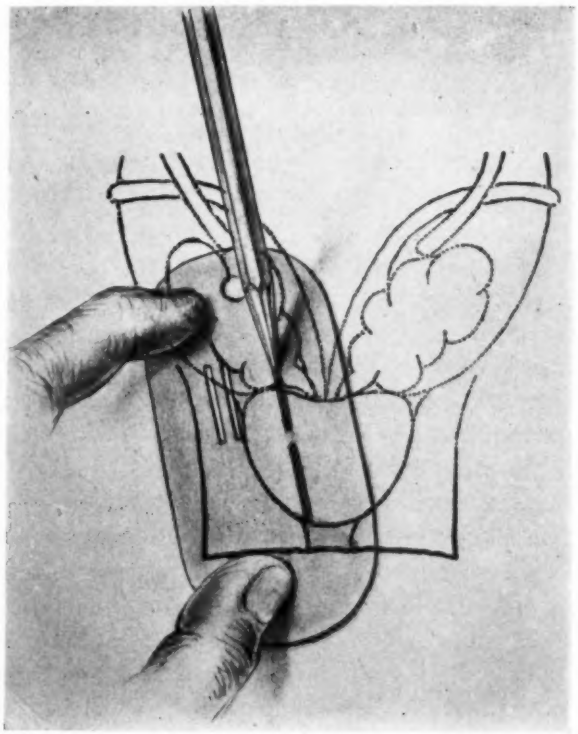

Fig. 2. Use of celluloid marker. Tandem tube radium applicator employed over left lobe of prostate.

In malignant papilloma, the use of radium applied through the cystoscope is of very great importance, although we usually alternate with fulguration, as we find that such combined treatment usually

greatly hastens the disappearance of the tumor. We have now followed 64 cases of malignant papillomata which have been treated by radium applied cystoscopically and by fulguration. Nineteen of these cases are free from recurrence on cystoscopic examination, and 14 patients who could not return say that they are free from symptoms now, three to ten years since treatment was completed. Four patients who had recurrence were given a second course of treatment, and are well now after periods of two, three and ten years. Six patients with recurrences were improved, and 4 patients died of recurrence. Eight patients are dead, apparently from other causes. Since a good many of these 64 cases were very extensive in character, and far beyond any possibility of resection, the results obtained in many of these cases have been indeed quite brilliant.

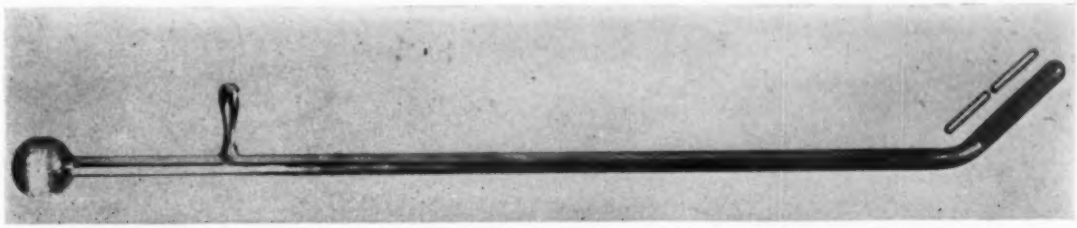

Fig. 3. Radium applicator carrying one or two tubes of radium (100 mg. each) in platinum tubes, beak being composed of silver surrounded by gutta-percha. Note fixation ball externally.

After an experience of about ten years with the endovesical cystoscopic application of radium, we are more than ever convinced of its great value. We employ two platinum tubes, of 100 mgh. each, which are usually placed side by side in the beak of Young's cystoscopic applicator. When the radium has been applied deeply against the tumor mass in a site selected by cystoscopic guidance, it is held there by fixation to the table, by means of a clamp. This clamp, which grasps the ball on the outer portion of the radium-bearing sheath, makes it possible to hold the radium in situ for a considerable period of time, generally an hour. In this way accurate applications are made to different portions of the tumor or other sites in the bladder without more overlapping than is desired. Cystoscopic burns of other parts of the bladder are thus prevented, and the whole area of tumor invasion is completely covered. Such cases are charted, as shown in Figures 1 and 2. If the tumor lies on the base of the bladder, the trigone or vesical neck, it can be reached from the rectum, the applications being made by my simple rectal and urethral applicator (Fig. 3), without the aid of the cystoscope, which is unnecessary in such cases. In this way tumors of the bladder may be subjected to a cross fire of radium which makes it possible to give them a considerable number of radium hours of treatment. As already remarked, not infrequently very extensive tumors disappear with surprising rapidity.

When the tumor is at the vesical neck, urethral applications may be of very distinct value and may include, not only the prostatic urethra, but the vesical orifice and the trigone and adjacent parts of the bladder wall. Such treatments are given under local anesthesia (4 per cent procaine in urethra and bladder), assisted, if necessary, with morphia, although caudal anesthesia may be employed very successfully in irritable cases. We usually employ Young's cystoscopic applicator No. 1, in which the radium is carried in the oblique beak of the instrument. Where the tumors are more distant from the central portion of the bladder, far out on the lateral or anterior walls, instrument No. 2, in which the radium is carried by a parallelogram mechanism (Fig. 4) out to a point about 3 cm. away from the cystoscope, may be more appropriate. For other positions in

the bladder, we sometimes employ instruments 3 or 4, by which the radium is carried in a position transverse to the cystoscope. By means of these various instruments it is possible to apply radium in considerable quantity to the bladder, and to hold it accurately in place for long periods of time, and thus obtain a large number of milligram hours of direct radiation. This technique is so effective that we usually employ it to the exclusion of suprapubic insertion of radium through open operations, and with results which are very satisfactory.

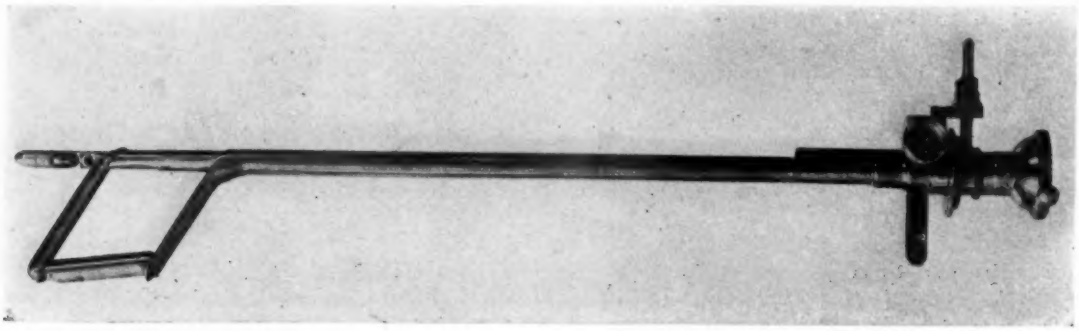

FIG. 4. Young's parallelogram cystoscopic radium applicator carrying 200 mg. radium in capsule.

In certain tumors of the base of the bladder, however, we are convinced that a suprapubic exposure with cautery resection of the endovesically projecting papillary outgrowth is preferable to the endovesical cystoscopic treatment. After using various types of technique, we believe that after removal of the intravesical portion flush with the bladder, the best method is to insert screened radium, either element or emanations, through the area of the base, and into the adjacent bladder wall, covering an area 1 cm. wide around the tumor, and leaving in place radium equivalent to 1 mg. per cubic centimeter of tissue. It is wise to use points containing no more than 1 mg., and it is probable that ½ or ⅓ mg., applied with correspondingly greater frequency, is even preferable to milligram doses. The bare glass tubes are undoubtedly not as satisfactory as the screened radium; since employing the latter we have rarely seen the extensive sloughs which were previously encountered in the use of the bare tubes. Where deeper structures, particularly around the prostatic orifice, are invaded, one may insert screened needles to a greater depth, and these needles may contain 10 or 12 mg. radium element.

For the purpose of these endovesical treatments, we have on hand 20 platinum needles, each containing 1 mg. radium element, and provided with a stout silk ligature with which to withdraw them, and in addition, three needles with handles attached, of 10 mg. each, and two of 12½ mg. each. We have usually found this armamentarium sufficient completely to encompass and infiltrate with radium any tumor masses that we have attacked through this suprapubic technique.

Our opinion is that tumors of the trigone which are apt to involve the deeper structures (seminal vesicles, ampullae, perirectal and retrovesical tissues) can be more radically attacked by the deep insertion of radium than is possible by the so-called radical resection which does not usually include these deeper structures. When we consider that there is very little mortality attending such methods with radium, whereas one suprapubic resectionist admitted a few years ago a mortality of over 30 per cent, the danger of the so-called hemisection in such cases is evident, and statistics are not yet forthcoming to show that the results obtained are superior. The great difficulty in arriving at the truth is the absence of thoroughly reliable, completely studied and well followed-up cases, and until such

are furnished, one cannot state accurately what can be accomplished by means of the very radical or extensive operations which have been recommended in malignant tumors of the base of the bladder.

Thirty-eight cases of papillary carcinoma were treated in our clinic by fulguration and by cystoscopic application of radium. It has been difficult to follow all these cases, but we are convinced from subsequent cystoscopic studies that 18 are well for periods up to ten years. It is believed that there are many more cases which are free from symptoms, as we would surely have been apprised, had there been recurrence in some of these cases; but here again the difficulty of knowing the exact truth is apparent.

In conclusion, we believe in radical resection of infiltrating malignant tumors of the bladder where this can be done safely, as in the case of tumors of the anterior, lateral and posterior walls and vertex of the bladder; that in such cases complete mobilization of the bladder, and so-called delivery externally, is not only unnecessary but inadvisable, in that it does not permit of radical resection of the adjacent peritoneal covering in tumors of the vertex and posterior wall. Another objection to stripping the bladder off from adjacent tissues is that important arteries supplying most of the bladder are severed and such vascular supply is important after operation. When extirpation of the deep lateral or posterior parts of the bladder is indicated, unilateral mobilization may be of great assistance; and, in fact, necessary for a complete operation; but owing to the proximity of other organs, (seminal vesicles, etc.) which are not removed by such operative resection, and their frequent invasion by carcinoma, the question arises as to whether such cases are not best treated by implantations of radium, as already stated. Time alone and much more careful study of cases than has heretofore been furnished will be necessary to settle some of these problems.

In considering these brief remarks, it seems just to say that since the introduction of endovesical methods of diagnosis and treatment, and the application of radium in the treatment of vesical tumors, great progress has been made. Fulguration has itself been one of the most important innovations in surgical history, but of equal importance and of more far-reaching effect is the endovesical use of radium. But with a combination of these methods, radical curves have been obtained which were heretofore impossible by surgical methods.

MALIGNANT DISEASE OF THE PROSTATE

Statistics of our clinic and several others, where large numbers of prostate cases are seen, show that about 20 per cent of the elderly men patients requiring treatment for obstructive conditions of the prostate had carcinoma. In one-half of the cases in our series, hypertrophy of the prostate was also present and this may obscure the diagnosis. On rectal examination in such cases, even though the posterior layer may be quite hard, the elastic hypertrophied lobes beyond may impart a sense of elasticity which may be deceptive. It is here that palpation of the suburethral portion of the prostate upon a cystoscope in the urethra is of great value, and when one finds marked increase in thickness and induration of the whole suburethral portion of the urethra, particularly that below the verumontanum, one may be very suspicious of carcinoma. An area of very great induration, even though it may appear encapsulated and confined to a small portion of the prostate, should be suspected. In some cases it may be a phlebolith, in others, a definite prostatic stone, in others, a very fibrous localized nodule of hypertrophy. The roentgen ray will demonstrate whether the indurated nodule is a phelbolith or calculus, but if one is still suspicious, exposure through the perineum to get direct palpation and if necessary, excision of the nodule for microscopic examination of the frozen section, are highly desirable. It is inadvisable to

wait and watch such cases, and although we have seen 1 case in which the growth was extremely slow, and at the end of two years was only slightly larger than when we first saw it, valuable time may be lost and metastases may occur. We are more than ever convinced that the radical operation for carcinoma of the prostate is indicated wherever the condition is at all favorable, that is when the disease is still within the capsule of the prostate, has not involved the membranous urethra, only extends a short distance into one or both seminal vesicles, and is not accompanied by glandular or other metastases. This radical operation is not very difficult. The capsule of the prostate, with the neck of the bladder, a large part of the trigone, seminal vesicles and the ampullae of the vasa deferentia should be removed in one piece (Fig. 5). The anastomosis required to close the defect is one of the easiest parts of the operation (Fig. 6) and remarkably successful in that in almost all cases a prompt and permanent healing is obtained, and without the formation of stricture. In fact, in 27 cases we have never seen definite stricture form at the site of anastomosis, and they have not required the passage of sounds. Our first operations were followed by incontinence, but since adopting a special technique, by which we have endeavored not to penetrate but stay behind the transverse anterior prostatic fascia, the important arteries, veins and nerves supplying the triangular ligament and external sphincter have been avoided, and complete urinary control has been secured. It is an interesting fact, and rather surprising to physiologists, that it is possible to have perfectly normal urination with intervals of from five to seven hours in cases where the entire prostate, with internal vesical sphincter and adjacent trigone, has been removed.

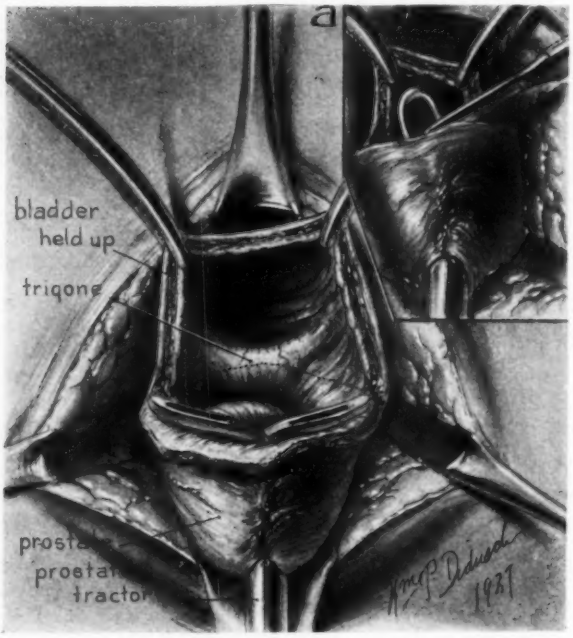

Fig. 5. Radical operation. *a*. Wound in bladder being enlarged on each side with scalpel. Incision runs close to vesicoprostatic juncture. Floor of bladder then exposed; trigone, ureters and median lobe of prostate then seen. Trigone cut across at point indicated by dotted line.

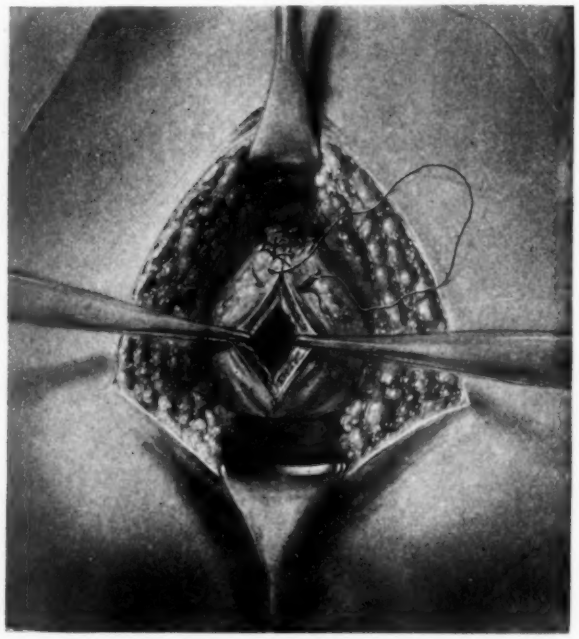

Fig. 6. Closure of remainder of vesical incision longitudinally, with continouus suture.

The results obtained by this operation may be summarized as follows: There was only 1 operative death in 27 cases. This patient died of shock a few hours after the operation, and autopsy showed an extensive intraperitoneal mass of carcinoma which had not even been suspected.

One patient died of recurrence eighteen months after the operation, and 2 died about two years after the operation.

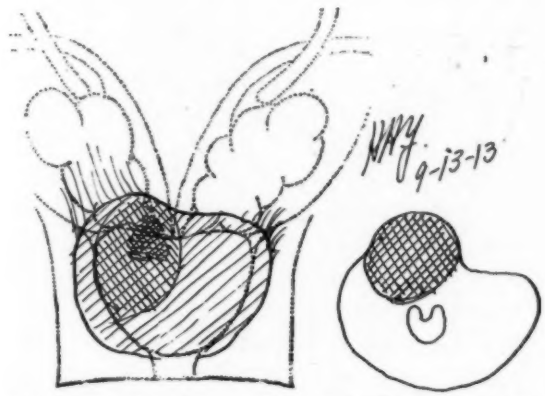

Fig. 7. Prostatic chart in Case VIII. Diagram made of prostatic examination showing hard lobule in left lobe. Radical operation September, 1913. Patient lived eight and one-half years, no evidence of recurrence.

Of these, 1 died suddenly of heart disease, and autopsy showed no recurrence; the other died from some unknown cause, but his physician thought no recurrence was present. Two patients lived three years, and died of recurrence. Five patients have been operated on within the last two years. All are apparently well, but it is much too early to speak of ultimate results. Eight are alive and apparently well for periods varying from three to thirteen years after the operation, 1 three years, 1 three and one-half years, 1 four years, 1 six years, 2 seven years, and 2 thirteen years. Some of these operated on by the most recent technique have normal urination, and one patient does not arise at all at night to urinate. Fifty-seven per cent of the patients operated upon seven years or more ago, have lived for periods of from seven to thirteen years without recurrence. The rectal findings in 3 of these cases treated by my radical operation are shown in Figures 7, 8 and 9. Three deaths have occurred from complications not due to malignancy. Seventy-two per cent of the patients have lived over a period of from seven to thirteen years since leaving the hospital without recurrence. Some of the cases were too far advanced for the radical operation, and it should not have been attempted. With improved methods, more careful work and

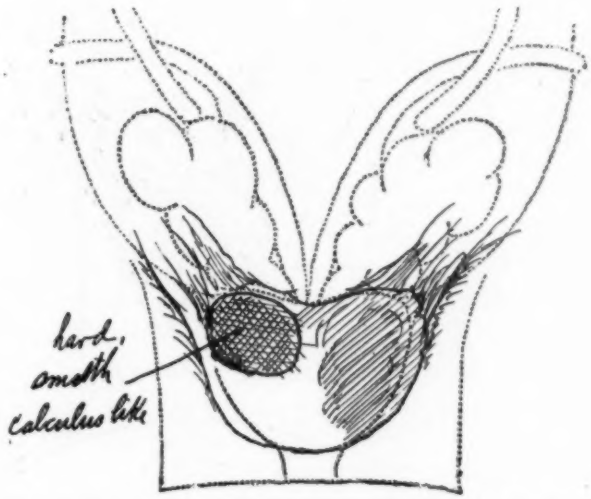

Fig. 8. Chart of rectal examination in Case XI. Radical operation April, 1914. Pathological report: carcinoma. Letter, October, 1927, thirteen years after operation, reported patient well, urination normal.

earlier diagnoses, this radical operation for carcinoma of the prostate should rank high for cures among the surgical operations for carcinoma. One of the most gratifying factors is the fact that many of these patients have had no incontinence,

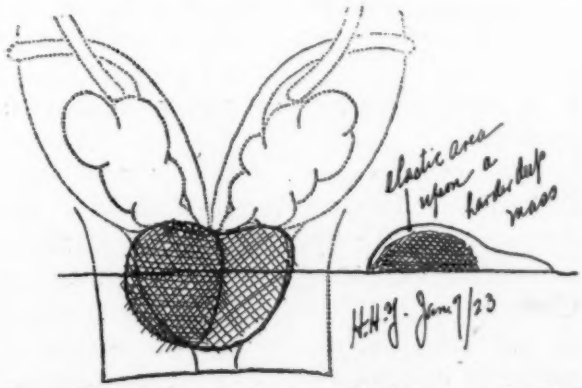

Fig. 9. Rectal chart in Case XX. Carcinoma confined to left lobe. Confirmed microscopically. Alive and well nearly six years later.

although the entire prostate, median and internal sphincters and most of the trigone have been removed.

Implantation of Radium by Operation, with the Hope of Cure. We have used this method both through perineal and

suprapubic wounds, but without a single complete success. It certainly is not to be considered as a radical cure, and it is, prostate can be treated by cross fire methods from the rectum, urethra and trigone, and in some cases remarkably

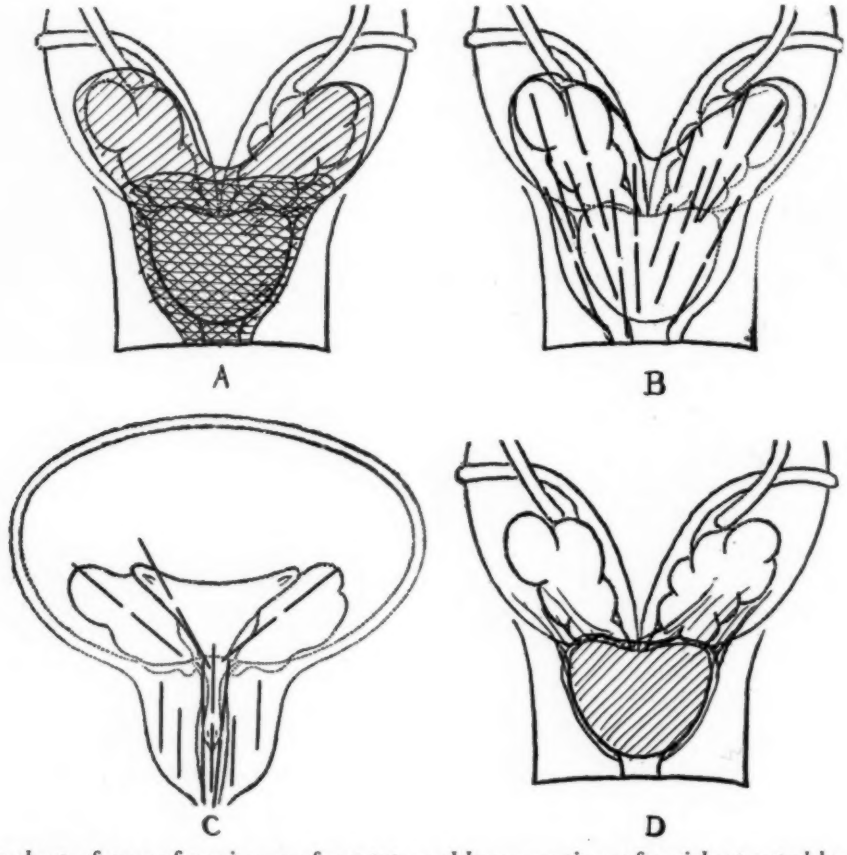

FIG. 10. Prostatic chart of case of carcinoma of prostate and lower portions of vesicles treated by radium. Treatment by radium applied: *a*, through rectum; *b*, through urethra and bladder, and *c*, by puncture through perineum. *d*, Marked decrease in size of prostate four months later as result of treatment.

I believe, inferior to other operative methods.

The Treatment of Carcinoma of the Prostate by Radium Applied through the Rectum and Urethra. In 1913 Pasteau and deGrais presented to the International Congress of Medicine in London a method of applying radium in the treatment of prostatic carcinoma by means of a catheter in the urethra which showed apparently remarkable results. Starting with this method, we have made various modifications and improvements, and now employ an applicator, as shown in Figure 3. This applicator carries two screened 100 mg. tubes of radium, and can be introduced into the rectum or through the urethra or bladder. In this way carcinoma of the beneficial results are obtained. To be effective, this method must be used with the clamp, previously described, by means of which the radium is held at the site desired. The treatments are charted as shown in Figure 10. For rectal applications the patient is placed on his side on a comfortable, well-padded table, with the legs flexed and the back against a padded rest, so that the position can be easily maintained. A finger covered with a rubber cot is inserted into the rectum, and by palpation the site for the treatment is determined. The applicator is then introduced by the side of the finger, placed at the predetermined site, and held there by a clamp attached to the table. The patient has no difficulty in

undergoing this treatment for an hour, and thus 200 mg.h. radium dosage is obtained at each treatment. For urethral applications the patient is placed on his back, the urethra properly sterilized, and anesthetized with 4 per cent procaine. The applicator, sterilized with pure carbolic acid which is then washed off with sterile water, is introduced slowly through the external sphincter, until by manipulation the operator is certain that it lies free in the prostatic urethra. If several applications are to be made the first may be made low down near the external sphincter, the second about the median portion of the prostatic urethra, and the third so as to project intravesically. The same instrument can be carried into the bladder (which has been previously partly filled with fluid), the beak turned, and the handle elevated so that the screened radium is made to lie against the trigone in a position not previously used. It is our practice usually to apply the radium through the rectum, urethra and trigonal region on successive days, and never to make an application in the same place a second time. In this way from 1500 to 2000 mg.h. radium may be applied to the region of the prostate and seminal vesicles without producing radium burns. Six hundred to 800 mg.h. may be safely given into the posterior urethra and vesical neck, and a similar amount through the trigone. The total amount of radiation which we often give is between 2000 and 3000 mg.h., and while transient irritation may be produced, definite ulceration is avoided. The immediate result obtained by this method is, first of all, complete cessation of hematuria, in cases in which this is present, a gradual reduction in the size of the carcinoma, with eventual lessening in the difficulty and frequency of urination and, in some cases, complete restoration to normal urination. In many cases the carcinomatous mass, as felt by rectum, undergoes great diminution in size and in some cases the prostate eventually feels normal on rectal examination. However, we cannot report a single cure in a case followed for a long period of years, and owing to the presence of metastases in most of these cases before operation, radical cures are not to be expected. But even where metastases are not present, and the tumor mass apparently disappeared completely, subsequent metastatic involvement occurred in most cases. The method, therefore, is not to be considered as a radical cure, and should never be used instead of the radical operation previously described, when the case is suitable for complete extirpation of the prostate and seminal vesicles. That wonderful betterment can be obtained in most cases has been proved by scores of cases in which this method has been employed at our clinic.

Introduction of Radium Needle through the Perioneum or Bladder. Here, again, we have no case of complete cure to report. In some cases there has been a great diminution in the size of the mass, and even an apparent disappearance of the carcinomatous involvement, but the results obtained have not been as satisfactory as those we have obtained with a simple application of radium through the rectum, urethra and trigone, and we no longer use needles. The bladder is sometimes opened for some reason in carcinoma of the prostate, and we have introduced the needles through the suprapubic wound. The 1 mg. needles with thread attached, and also the needles with larger amounts, attached to a shaft, have been employed. In a few cases immediate improvement and a restoration of voluntary urination have been obtained, but here again, no radical cures have been secured.

Conservative or Partial Resection of the Lateral and Median Lobes of the Prostate to Remove Obstruction. This method, which was first employed by us in 1904, has been used in several hundreds of cases. The technique is similar to that which has been described for perineal operations in benign cases. It is particularly applicable where lateral hypertrophy of the prostate is

present concommitant with the carcinoma of the posterior portion of the prostate, and the results obtained are surprisingly satisfactory. The technique is shown in Figures 11 and 12. The immediate closure of wounds in these cases is equally as rapid as in the cases of benign hypertrophy of the prostate, and in a large majority of the cases, no obstructive symptoms re-appear, and usually the patient has urinary comfort as long as he lives. This method, we believe, is far preferable to the simple suprapubic drainage which has been considerably advocated. In my experience, suprapubic drainage is at best difficult to maintain satisfactorily, is uncomfortable and often painful. By means of conservative partial prostatectomy, a wonderfully good functional result is obtained, and in many cases, almost normal urination secured which may continue as long as the patient lives.

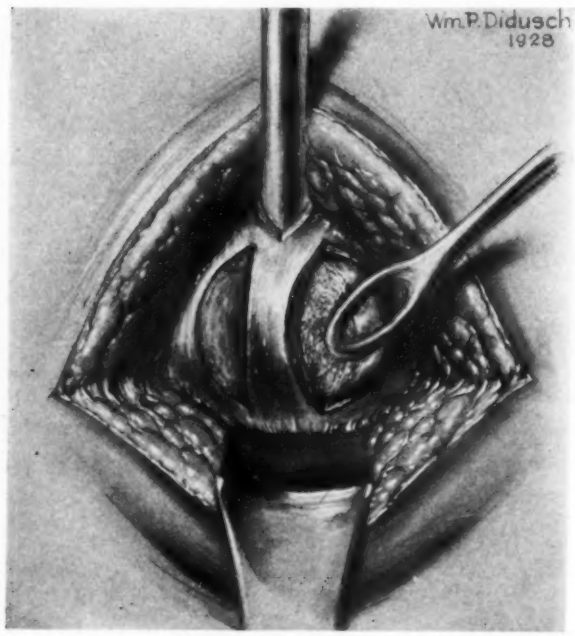

FIG. 11. Young's conservative intracapsular resection of lateral lobes of prostate through perineum, to remove obstruction in case of carcinoma.

The punch operation may also be successful in removing obstruction, but only when hypertrophied lobes are not present. It is best suited to bars at the prostatic orifice. I have reported its successful use after a course of rectal and urethral radium had greatly reduced the prostatic mass, but obstruction at the prostatic orifice persisted.

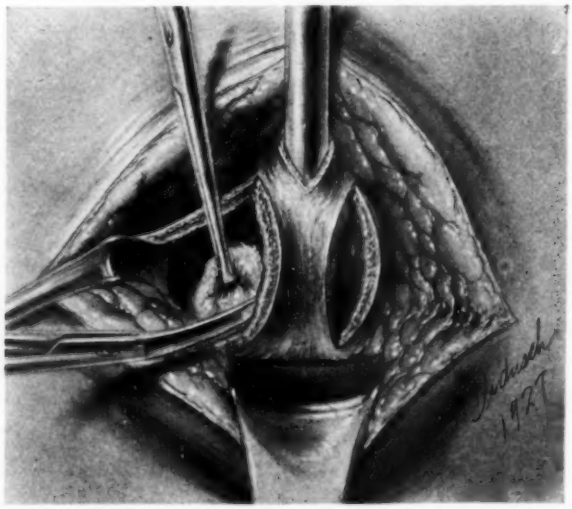

FIG. 12. Conservative perineal prostatectomy to remove obstruction in carcinoma of prostate. In this case lateral masses have been removed first and median lobe is being dissected out separately from in front of ejaculatory ducts.

Résumé. If the diagnosis of carcinoma of the prostate can be made sufficiently early, radical operation on the prostate, with its capsule, seminal vesicles, neck of the bladder, and part of the trigone, excised in one piece, should be carried out. With this operation, a large percentage of cures should be obtained. In later cases the use of radium through the urethra, bladder and rectum is effective, particularly in stopping the hematuria and increasing the interval and ease of urination. With marked obstruction to urination, or complete retention, conservative perineal prostatectomy, with removal of the lateral and median portions of the prostate, careful preservation of the mucous membrane of the urethra and vesical neck, is a remarkably good method, and lasting good results have been obtained in a large percentage of the cases. The punch operation also has an important place.

SARCOMA OF THE PROSTATE.—A careful review of our records shows 20 cases of sarcoma of the prostate and its adnexa.

We have found these cases to be of four types: (1) those in which the prostate alone is involved, 2 cases; (2) those involving the prostate and seminal vesicles, 10 cases; (3) those involving only the region of the seiminal vesicles, 5 cases; (4) those lateral but adjacent to the seminal vesicles, 3 cases. Two of these cases have been subjected to operation with poor results. Most of the others have been treated with radium with some remarkable disappearances of a very large sarcomatous tumor. Four cases were apparently cured completely. One of these patients has been followed for three years, 2 seven and one-half years, and 1 eleven years. In all these cases the application of radium through the rectum and also through the urethra and trigone was followed by rapid diminution in the tumor, and eventually complete disappearance. In most cases, after a full amount of radium had been employed, deep roentgen-ray therapy was also used with apparent benefit. While the use of roentgen-ray therapy has not been positively beneficial in many cases of tumors of the bladder and in carcinoma of the prostate, we are convinced that it is of great value in

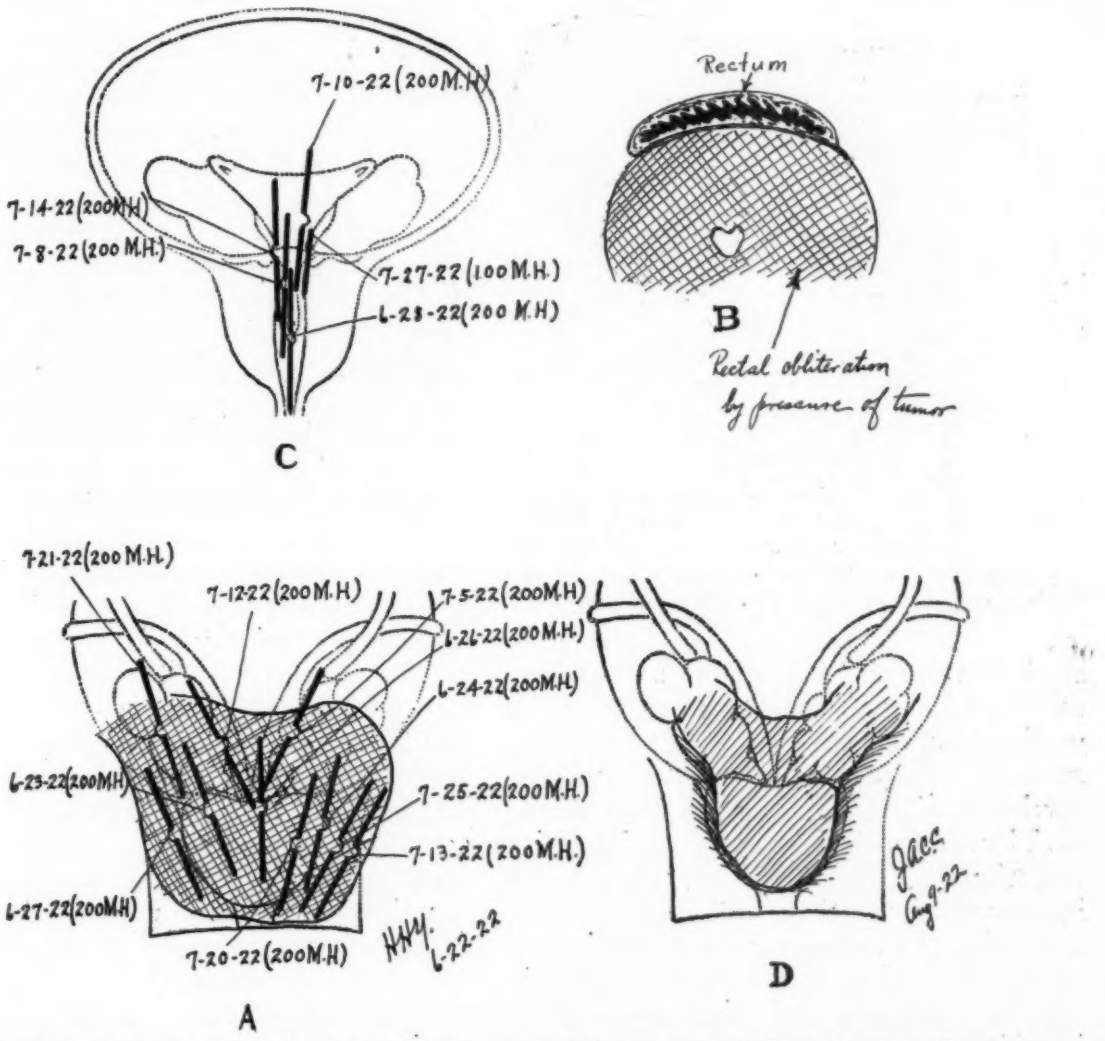

Fig. 13. *a*, Chart of rectal examination in case of sarcoma of prostate on which applications of radium per rectum are shown with dates and milligram hours. *b*, Cross section showing great size of tumor and manner in which rectum was pressed. *c*, Chart showing applications of radium made through urethra. *d*, Rectal chart, same case, two and one-half months later, showing prostate reduced to normal size and apparent complete disappearance of tumor. Patient now well seven years.

the treatment of sarcomas of the prostatic region, but radium should always be employed. Owing to the widespread extent

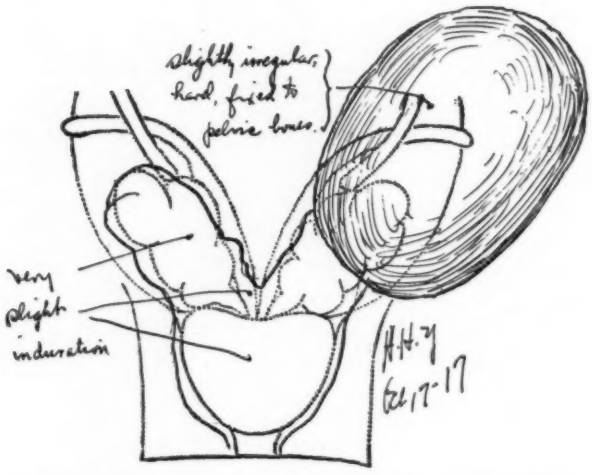

FIG. 14. Sarcoma of ischiorectal fossa between bladder, rectum and pelvic wall, involving seminal vesicles. Treated by radium applications with complete disappearance of tumor. Followed seven and one-half years. Apparent complete cure. Urination normal.

of these tumors, large amounts of radium can be used without danger of rectal or urethral burns. The extent of the tumor, and the application of radium and the results obtained are shown in Figures 12–14. The extraordinary results obtained with radiotherapy in sarcomas should be impressed upon the medical profession. They should be impressed with the importance of making rectal examinations in obscure pelvic and abdominal disease both in children and adults, and to suspect retrovesical enlargements of the prostatovesicle regions. Some of these tumors are very soft, and most of them elastic. Occasionally they are quite inelastic and hard. The diagnosis of sarcoma is usually apparent. The fact that many occur at a much earlier age, even in infancy, contrasts them definitely with carcinoma of the prostate.

CONCLUSIONS

In conclusion I wish to say that the last ten years has seen great strides made in the cure of malignant tumors of the bladder and prostate. Whereas surgery has made great progress, particularly in the radical resection of the tumors of certain portions of the bladder and in carcinoma of the prostate, the greatest benefit has been obtained by the use of endovesical treatments of high-frequency electrical applications and the use of radium, with or without the use of the cystoscope. The principal difficulty is still in the lateness of diagnosis. If the medical profession could be persuaded to institute careful rectal and vesical examinations in all cases of urinary, lower abdominal or pelvic complaint, many early tumors of the prostate and bladder would be detected and brought to prompt curative operation. If the profession could appreciate Osler's dictum that "the difference between a good doctor and a poor one is that the good doctor knows how to do a rectal examination," many more early cases of malignant disease could be brought to the surgeon for a cure. With the use of modern methods radical cures can be obtained in malignant disease of the bladder and prostate in a surprisingly large number of cases, and the results compare very favorably with those obtained in malignant disease in other parts of the body.

The American Journal of Surgery

Publishing the Transactions of THE AMERICAN ASSOCIATION FOR THE STUDY OF GOITER; THE PACIFIC COAST SURGICAL ASSOCIATION, THE NEW YORK UROLOGICAL SOCIETY; SECTIONS OF SURGERY, GENITO-URINARY SURGERY AND ORTHOPEDIC SURGERY OF THE NEW YORK ACADEMY OF MEDICINE; LOS ANGELES SURGICAL SOCIETY, ETC.

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EDITORIALS

CANCER AND TUBERCULOSIS

IN an editorial on "Cancer Control" published in this journal last June,[1] the reader's attention was called to a suggestive feature in public health reports from all over the world, i.e.: the steady decline in the number of deaths from tuberculosis and the equally steady advance of cancer. In England, during the period 1871 to 1875, the mortality rate per million in the two diseases was as follows: tuberculosis 2217; cancer 445; while that of a later period, 1906 to 1910 was: tuberculosis 1106; cancer 939.

During the last year much attention has been given to the subject of cancer and tuberculosis and two papers of unusual interest have been published. One of these is by Raymond Pearl[2] who bases his study upon the extensive autopsy material of the Johns Hopkins Hospital. Pearl believes the problem, the constitutional differences between the tuberculous and the cancerous, to be primarily a statistical one; and he has compiled a series of excellent tables dealing with various aspects of the problem. In his discussion thereof, two questions come under consideration, i.e.:

1. To what extent, in point of frequency, was tuberculosis, active or healed, associated with the presence of malignant neoplasms in the 816 cases of malignancy comprised in this autopsy material?

2. Were tuberculous lesions, active or healed, found at autopsy more or less frequently in this group of 816 cases of malignant neoplasms, than such lesions would be expected to be found in an equal number of non-cancerous persons, of the same age, sexes, and races as the 816 persons composing the cancerous group?

To quote Pearl:

Active tuberculous lesions were found at autopsy in only 6.6 per cent of 816 persons having malignant growths of one sort or another and in 16.3 per cent of 816 persons without malignant tumors, but of the same

race, sex, and age as the former group. In short, active tuberculous lesions occurred over twice as frequently in the controls as they did in the malignant group in the present material taken as a whole.

In both the malignancy and the control groups the percentage of cases showing active tuberculous lesions is smaller in the females than in the males, with the exception of the small group of colored female controls. This exception is probably in no wise significant, but instead represents merely a chance deviation of sampling incident to the small numbers involved. In general the sex incidence of active tuberculous lesions in the material here under discussion accords with the well known fact that the rate of mortality from tuberculosis tends to be lower in females than in males . . .

Considering separately the carcinomatous and the sarcomatous groups, it is seen that the same general relationship exists in both relative to the infrequent coincident occurrence of malignancy and active tuberculosis. But the apparent antagonism between these two pathological states is more marked in the sarcomatous group, as compared with its control group, than in the carcinomatous group. Thus, taking the last line of the table (not given here) which is the average of all the data, it is seen that active tuberculous lesions occur 2.2 times more frequently among the controls of the carcinomatous than among those having carcinoma; whereas such active tuberculous lesions occur 3.3 times more frequently among the controls of the sarcomatous than among those having sarcoma. It should not be overlooked that this difference is to be expected, in some part at least, from the fact that the average age of those dying of sarcoma is lower than the average of those dying of carcinoma.

Pearl calls attention to the fact that tuberculosis is, on the whole, a disease predominantly of early life, and cancer is a disease predominantly of later life. A study of a table comprising 1632 autopsies arranged in separate decades of age, leads Pearl to the following conclusion: "In each decade of age, over the whole life span, cancer or other malignant tumors occur less frequently in those with active tuberculosis, than in either the non-tuberculous or those with old healed lesions. The only exceptions are in a few instances where the number of individuals involved is too small to give a reliable result."

The long-recognized antagonism between cancer and other infectious diseases, particularly tuberculosis, is pointed out by Pearl. According to the latter, Rokitansky[3] was the first to attempt any real analysis of the problem. He stated that in the sites where tuberculosis is frequently found, for example, the lungs, cancer is rarely found. Hirschowitz,[4] in an analysis of five years' autopsies at Prage, found cancer in only 4 of 944 deaths from tuberculosis. According to Pearl:

There is evidence that the infrequent occurence of cancer and active tuberculosis together is not a unique phenomenon but instead is only one of the manifestations of the tendency towards the non-association of cancer and infectious diseases . . . The evidence set forth in the first part of this paper seems conclusive, to an overwhelming degree, to the effect that florid active tuberculosis and cancer occur together only with the greatest rarity. This obviously suggests an experimental enquiry to determine whether the presence in any animal of much active tuberculosis protects at any degree against the aquisition of cancer or retards or inhibits the growth of a malignant tumor already present . . . Centanni and Rezzesi[5] worked with a strain of mice rather highly resistant to infection with the tubercle bacillus, and a transplantable adenocarcinoma which had a virulence of about 100 per cent. Injection of a mixture of cancer cells and living tubercle bacilli produced no tumors. Simultaneous injections of these two materials separately in different parts of the body depressed the rate of development of the tumor, though in some cases only temporarily. Previous infection of the animals with tubercle bacilli delayed the development of the subsequently inoculated tumor. Injection of the bacilli into an already growing tumor partially destroyed it, but some of the animals died with toxic symptoms. Dead tubercle bacilli had no influence in parallel experiments. Tuberculin mixed with the tumor emulsion retarded or inhibited growth.

McCaskey[6] expresses the opinion that "In view of these apparent antagonisms,

and the occasional retrogression of cancer after the use of tuberculin (though very doubtfully attributable to the latter), it would seem worth while in properly selected inoperable cases of cancer to try the systematic local injection of tuberculin in the cancerous tissue." At the suggestion of Pearl, a small number of carefully selected cases of malignancy are now being treated by Dr. Alan C. Sutton, a member of the staff of the Johns Hopkins Hospital, under the direction of and in consultation with the former.

In a summary of his studies, Pearl points out the interesting fact that:

> In 886 persons of both sexes and races compared, who had *a great deal of florid, active tuberculosis* (acute, ulcerative tuberculosis of the lungs or intestines, tuberculous meningitis, caries of the vertebrae, etc.), there were but 11 cases of malignant tumors, or 1.2 per cent of the total number. On the other hand, in 886 persons with no recorded lesions of tuberculosis at autopsy, having the same age, sex and racial distribution, case for case, as the very actively tuberculous, there were 82 cases of malignant tumors, or 9.3 per cent. Among the females, both white and colored, there was not a single case of malignant growth in those with much active tuberculosis. This general result is confirmed in each separate age, sex, and color group, save for a few cases where the numbers are too small to give any reliable indications whatever.

It may be recalled that in the editorial already mentioned[1] a brief reference was made to Cherry's paper on "Cancer and Acquired Resistance to Tubercle."[7] Since then this author has published a very elaborate paper on "The Tubercle Bacillus and Cancer in Mice."[8] It is most interesting to compare his observations with those of Pearl.

According to Cherry, mice were selected as best suited for such an investigation because they are liable to spontaneous cancer and also highly resistant to tuberculosis. Seventy-four were inoculated immediately beneath the cuticle of the skin and 22 at the corresponding depth at the margin of the mucous membrane of the lip.

He states:

> The emulsion was prepared from a glycerine-agar slope about a month old, rubbed up in sterile salt solution to which a trace of bicarbonate of soda had been added. When by the opacity it was estimated to be above one thousand millions per cubic centimetre it was spun at three thousand revolutions for one minute and used at once, the needle being charged from the upper supernatent fluid layers. After the inoculations were completed, the number of organisms was determined by the haemacytometer count and also by Breed's method,[9] the amount delivered by the needle being already known.
>
> The estimate of the number inoculated varied from 5,000 to 150,000 from different emulsions. On the average cultures of tubercle bacilli contain about 4,000 millions to the milligramme. Hence a dose of 100,000 bacilli is equal to one forty-thousandth milligramme. The actual number of the bacilli is of less importance than the uniformity of the dose delivered by the needle. Five hundred gramme guinea pigs were inoculated beneath the cuticle from the emulsion used. Three of these receiving 150,000 bacilli have died at periods of 141, 145 and 155 days after inoculation. In a second series receiving 100,000 organisms three have died at 166, 173 and 175 days respectively.

In this study, the term "cancer" is used to include all forms of malignant tumors.

According to Cherry, these experiments show that:

> Minute doses of tubercle bacilli in mice are followed by varied conditions including: (1) Tuberculoma, (2) lymphoid hyperplasia running on to leuchaemia and lymphosarcoma, (3) sarcoma, adenoma and carcinoma, some of which have characters not before described in mice, (4) the bacilli may remain recognizable in the tissue for at least half the lifetime of the mouse, (5) as the lymphocytic reaction persists this may be taken as evidence of the presence of a chronic irritant, presumably the bacilli . . .
>
> Various strains of bacteria have been isolated, inoculation of which is followed in a variable percentage of cases by the appearance of true tumors both mesoblastic and epithelial. Some of these are transplantable into other mice, but the bacilli cannot be found in the secondary growths or in the transplants.

Animal parasites both in the lower animals and in man, chemical substances taken internally and external irritans, such as radiant energy, heat and tar, are all well established as causes of tumors.

In these instances true tumors are produced and the value of such clinical and experimental results is not the light that they throw on the cause of the common forms of human cancer, but in demonstration of the fact that cancer is caused by a number of unrelated internal and external irritants. The apparent causes are multiple, the resulting product—malignancy—is a unity. Hence it is almost certain that these are the indirect causes and that the unity is achieved through a specific mechanism which they set in motion and which becomes the direct cause of the tumor. Malignant growths in their essentials are always the same, because they consist of a part of the body which has acquired the power of unrestricted growth. Among the higher animals they thus constitute a separate physiological phylum.

This "specific mechanism" mentioned by Cherry may be the "specific factor" of Gye.[10] In our opinion, Gye's theory comes nearer to solving the problem of the etiology of cancer than does anything that has as yet been proposed. At this point it may be well to repeat a statement made in our earlier editorial[1] already referred to (June, 1928), as follows:

The lack of complete confirmation of Gye's laboratory experiments does not materially weaken the theory presented. Perhaps he tried to prove too much. In dealing with the problem of human cancer we do not need to go as far as to assume that the microbic agent is actually destroyed but that it is simply reduced in virulence. We need only assume that the body cells normally have such a high degree of resistance to the infection that it is harmless until this resistance is broken down by some of the factors mentioned. We may never be able to produce in the laboratory the exact conditions that obtain in the human body, but from what we do know of the possibility of breaking down the resistance of certain microorganisms by simple chemical changes in the body fluids, it is quite permissible to assume that similar changes may be brought about in the development of malignant tumors.

Cherry summarizes his remarks as follows:

1. The effects of inoculation of small numbers of tubercle bacilli beneath the cuticle by the method described in a series of 96 white mice are recorded.

2. The incidence of tumors in the stock of mice used is 6 per cent. After inoculation it rose to 55 per cent in the males and 71 per cent in the females. About one-third of these tumors are mesoblastic and two-thirds epithelial.

3. In range of type and situation this series of neoplasms differs materially from any hitherto recorded in mice. Those arising in the thyreoid, pylorus, colon, pancreas, prostate and bladder have not hitherto been observed in this animal.

4. These mice also exhibit an associated syndrome of lymphoid changes. The relationship of these on the one hand to leuchaemia and pseudo-leuchaemia and on the other hand to lymphosarcoma is traced and the aetiology of the condition discussed.

5. Death occurred on the average in eight and a half months after inoculation. The occurrence of tuberculomata, the finding of acid-fast bacilli in 10 per cent of the mice and the lymphocytic character of the associated lesions are held to indicate that the bacilli have established themselves in the tissues.

6. The facts submitted afford strong presumptive evidence that the tubercle bacillus is the indirect but essential agent in the promotion of neoplastic growth in these mice. Suggestions are made as to the possible mode of its action.

7. Intraperitoneal inoculation of corresponding doses of bacilli in fourteen mice gave negative results in regard to the presence both of tumors and lymphoid syndrome.

In Cherry's experiments it is admitted that the strain of mice employed was highly resistant to the tubercle bacillus. These experiments, however, would seem to prove that the tubercle bacillus when given in certain quantities may act as

another example of a specific factor that breaks down the resistance of the normal cells to the unknown agent which is the cause of malignant tumors. The autopsy studies of Pearl, on the other hand, gives strong confirmation of the opinion that there exists a definite and powerful antagonism between tuberculosis and cancer. It is difficult to explain this action on any other theory than that the causative agent of the various types of malignant disease, grouped under the general term of cancer, is of microbic origin. This opinion is strengthened by the definite knowledge that a number of various other diseases all of bacterial origin, notably erysipelas, have the same antagonistic action. Pearl's reference to Eschweiller's paper[11] does not mention any of the clinical facts contained in the latter. In brief, Eschweiller who made a very complete study of the effect of accidental erysipelas upon malignant tumors, collected 69 cases from the literature; 27 of these were sarcoma, 38 carcinoma, and 5 were of an undetermined type. Of the sarcoma group, 7 showed temporary improvement, the tumor entirely disappeared in 10, and in one case the disease disappeared but later recurred; there were 9 apparent cures, and 4 patients were well from two to eight years. In the 38 carcinoma cases, 12 showed temporary improvement, in 8 the tumor entirely disappeared, in 3 a recurrence followed the disappearance of the disease, there was no apparent effect in 9 cases, and in 6, the patient died of an attack of erysipelas. In view of the fact that it has been found possible to utilize the curative action of the streptococcus of erysipelas on malignant tumors by the employment of killed cultures,[12] it would seem highly important to carry out a similar experimental study of the action of the tubercle bacillus upon malignant tumors in human beings. The results of the experiments now being conducted at the Johns Hopkins Hospital will be awaited with great interest.

William B. Coley.

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THE THIRD ANNIVERSARY

THIS is the third anniversary of THE AMERICAN JOURNAL OF SURGERY, New Series. In celebration of this event we asked Dr. William B. Coley to edit this issue. The contents of the May number are noteworthy in that Dr. Coley has presented a truly "all star cast." Every contributor is a man of national or world-wide reputation. Dr. Coley has set a precedent that will stand as an editorial achievement for a long time.

The American Journal of Surgery begins its fourth year under the imprint of Paul B. Hoeber, Inc., with great expectations for the future. In the past year it has added several thousand new subscribers to its lists. We have received hundreds of letters from readers from all parts of the country telling us they liked the material offered them. Many made helpful suggestions which we are putting into effect. What pleases one does not please the other and no one can satisfy everyone all the time, but on the whole the great majority of our readers seem to have found the JOURNAL and its practical everyday workable type of article to their liking.

We have splendid plans for the future. We have material in hand for some notable issues. We can assure our readers about one hundred and fifty pages of interesting reading matter each month. We truly base our promises for the future on the achievements of the past.

THE AMERICAN JOURNAL OF SURGERY'S circulation is scattered to every state in the Union. Every city of any size has its subscribers, but the impressive fact is that thousands who receive THE AMERICAN JOURNAL OF SURGERY live in little, crossroads villages.

The editor and publishers are eager for constructive criticism. We believe there is a definite place for a journal of this type. We also admit there are other needed excellent surgical journals and that they play important rôles in American surgery.

To Dr. William B. Coley, to the contributors to the American Journal of Surgery for the past year, and to our subscribers we send birthday greetings and best wishes.

In this issue articles are placed alphabetically according to author. Each article is of such importance that any other arrangement seemed inadvisable.

T. S. W.

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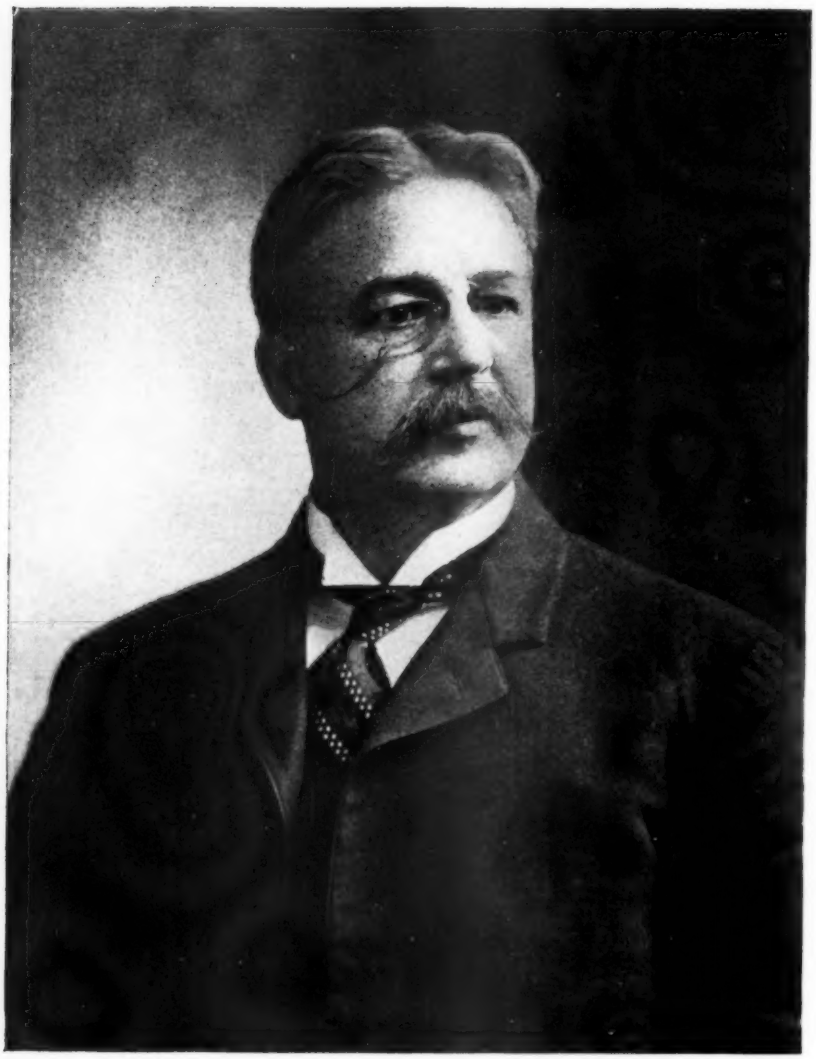

GEORGE RYERSON FOWLER, M.D.

[1848-1906]

The American Journal of Surgery
N. S. Vol. VI, May, 1929

[From Young: Annals of the Barber Surgeons. London, 1890.]

THE FOWLER POSITION

GEORGE RYERSON FOWLER was born in New York City, December, 25, 1848. He died February 6, 1906 following an operation for appendicitis.

He graduated with the degree of M.D. from the Bellevue Hospital Medical College in 1871.

He practiced in Brooklyn, engaging in general practice for 15 years, after which time he did surgery exclusively, having one of the largest practices in this field on the American continent.

His scientific connections were numerous. Dr. Fowler during his career was Visiting Surgeon to the Bushwick Hospital (six years later Consulting Surgeon), St. Mary's Hospital, Methodist Episcopal Hospital, German Hospital, Surgeon-in-Chief to the Brooklyn Hospital, Consulting Surgeon to the Relief Hospital of the Eastern District, the Norwegian Hospital and St. Mary's Immaculate Hospital of Jamaica, N. Y. For five and a half years he was Professor of Surgery of the New York Polyclinic Medical School. He then became Professor Emeritus of Surgery at that institution.

Among Dr. Fowler's society affiliations were: Fellow and Treasurer, American Surgical Association, Vice-President, New York Academy of Medicine, New York Surgical Society, Brooklyn Surgical Society, Brooklyn Pathological Society, Medical Society County of Kings (President and at the time of his death, Chairman of the Board of Trustees), Membre de la Société Internationale de Chirurgie, and Honorary Member of the National Association of Railway Surgeons.

He was appointed Examiner in Surgery to the Board of Regents of the University of the State of New York.

He ran the gamut of the National Guard of New York State from regimental assistant surgeon to surgeon general. He served in Cuba throughout the Spanish-American War, being commissioned by President McKinley as Chief Surgeon of Division, United States Volunteers, with the rank of Major.

In 1897 he was a delegate to the International Medical Congress which convened in Moscow, Russia, and again to one in Paris in 1900.

In 1890 the Red Cross Society of Brooklyn was organized and Dr. Fowler was elected president.

He was a voluminous writer on surgical subjects. For several years he was Associate Editor of the *Annals of the Anatomical and Surgical Society*, afterwards the *Annals of Surgery*. He wrote a treatise on Appendicitis in 1894 which was revised and enlarged in 1900 and translated into German and published in Berlin in 1896. At the time of his death Dr. Fowler had finished two volumes on General Surgery.

His name will long be associated with general surgery, especially with thoracic surgery and in abdominal surgery with appendicitis, and with the position, worked out with his son, Dr. Russell S. Fowler of Brooklyn, in the treatment of general peritonitis, internationally known as the "Fowler position." T. S. W.

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

WITCHCRAFT IN PENNSYLVANIA

FRANCIS R. PACKARD, M.D.

PHILADELPHIA

IT would hardly be thought possible that witchcraft would enter seriously into the trial of a criminal suit in the courts of the State of Pennsylvania, yet such has been the case, and the writer has in his possession a book which figured prominently in the testimony at the trial. Briefly stated, the chief facts in the case were as follows: A farmer named Hess living with his family not far from York, Pennsylvania, suffered various misfortunes to his chickens and crops. In that neighborhood, there practiced quite a few "witch" or "hex" doctors. The Hess family consulted one of these "hex" doctors, named John H. Blymer, who told them that they had been "hexed" by an elderly farmer named Nelson Rehmeyer, and that they could deprive him of his power of casting spells upon them in two ways, by cutting off a lock of his hair and burying it eight feet under ground, or by securing possession of a book which Rehmeyer had in his possession, entitled, "The Long Lost Friend." The hex doctor Blymer, who was thirty-nine years old, accompanied two boys, William Hess, aged eighteen years, and John Curry, fifteen, to Rehmeyer's house, where they seized him, tried to cut off a lock of his hair, and get the book. The unfortunate victim of their superstitious credulity put up a vigorous fight and was killed in the struggle. His assailants were brought to trial at York, Blymer and Curry found guilty of first degree murder, and sentenced to life imprisonment. Hess was found guilty of second degree murder.

During the trial much evidence was directly or indirectly brought forward showing how widespread was the belief in witchcraft in York County. A similar condition prevails in many parts of Lancaster County.

The writer's copy of the book which was supposed to enable Rehmeyer to cast his spells on the Hess family was purchased in the city of Lancaster on a newsstand in 1920. A number of copies were for sale along with the latest novels and the current newspapers and magazines.

It is a small book, bound in cloth, with the following title: "The Long Lost Friend, containing mysterious and invaluable Arts and Remedies, for Man as well as Animals, with many proofs of their Virtue and Efficacy in Healing Diseases, by John George Hohman, Lancaster, Pa.: Printed for the Purchaser, 1912."

Following the title page is a page which bears the following inscription:

☞ Whoever carries this book with him, is safe from all his enemies, visible or invisible; and whoever has this book with him

cannot die without the holy corpse of Jesus Christ, nor be drowned in any water, nor burn up in any fire, nor can any unjust sentence be passed upon him. So help me.†††

The preface to the first edition follows. It is a curious melange of quotations from the Scriptures, and abuse of doctors, in defence of what the Author calls "Sympathetic Words," in other words, what we now term "sympathetic magic." A few brief quotations will suffice to illustrate its purport:

Where is the doctor who has ever cured or banished the panting or palpitation of the heart, and hideboundness? Where is the doctor who ever banished a wheal? Where is the doctor who ever banished the mother-fits? Where is the doctor that can cure mortification when it once seizes a member of the body? All these cures, and a great many more mysterious and wonderful things are contained in this book; and its author could take an oath at any time upon the fact of his having successfully applied many of the prescriptions contained herein . . . whatever cannot be cured by sympathetic words, can much less be cured by any doctor's craft or cunning.

The Preface concludes: "Given at Rosenthal, near Reading, Berks County, Penna., on the 31st. day of July, in the year of our Lord, 1819. John George Hohman, Author and Original Publisher of this book.

We have been unable to find out any details concerning Hohman, beyond a few boastful statements of his successful practice contained in the pages of his book. He states that it is "partly derived from a work published by a Gipsy, and partly from Secret Writings, and collected with great pain and trouble from all parts of the world, at different periods."

The following are selected from a few of the "Testimonials, which go to show at any time, that I Hohman, have successfully applied the prescriptions of this book":

Katherine Meck, at that time in Alsace township, suffered very much from a wheal in the eye. In a little more than 24 hours, the eye was healed . . .

Michael Hartman, Jr., living in Alsace township, had a child with a very sore mouth. I attended it, and in little more than 24 hours, it was well again . . . Jacob Stouffer, at Heckak, Bucks County, had a little child who was subject to convulsions every hour. I sold him a book containing the 25 letters; and he was persuaded by his neighbor, Henry Frankenfield, to try these 25 letters. The result was that the child was instantaneously free from convulsions, and perfectly well. These letters are also to be found in this book.

In conclusion we will give some examples of the "Arts and Remedies."

A good Remedy for Hysterics (or Mother-Fits) to be used three times.

Put that joint of the thumb which sits in the palm of the hand on the bare skin covering the small bone which stands out above the pit of the heart, and speak the following at the same time:

Matrix, patrix, lay thyself right and safe,
Or thou or I shall on the third day fill the grave.†††

Another Remedy for Hysterics and for Colds.

This must be strictly attended to every evening, that is: whenever you pull off your shoes and stockings, run your finger in between all the toes, and smell it. This will certainly effect a cure.

To attach a Dog to a person, provided nothing else was used before to effect it:

Try to draw some of your blood, and let the dog eat it along with his food, and he will stay with you. Or scrape the four corners of your table while you are eating, and continue to eat with the same knife after having scraped the corners of the table. Let the dog eat these scrapings, and he will stay with you.

A good Remedy for bad Wounds and Burns.

The word of God, the milk of Jesus, mother, and Christ's blood, is for all wounds and burnings good.†††

It is the safest way in all these cases to make the crosses with the hand or thumb three times over the affected parts; that is to say, over all those things to which the 3 crosses are attached.

To banish Convulsive Fevers.

Write the following letters on a piece of white paper, sew it in a piece of linen or muslin, and hang it around the neck until the fever leaves you.

A b a x a C a t a b a x
A b a x a C a t a b a x
A b a x a C a t a b a
A b a x a C a t a b
A b a x a C a t a
A b a x a C a t
A b a x a C a
A b a x a C
A b a x a
A b a x
A b a
A b

Cure for Epilepsy.

Take a turtle dove, cut its throat, and let the person afflicted with epilepsy drink the blood.

A good way to cause children to cut their teeth without pain.

Boil the brain of a rabbit, and rub the gums of the children with it, and their teeth will grow without pain to them.

There are also spells to prevent fires, to compel thieves to restore stolen goods, to release spellbound persons, to prevent becoming charmed or bewitched, as well as to bewitch, and a number of recipes for dyes of various colors.

It is hard to believe that a compilation of such absolute nonsense and superstition can be permitted, or find readers at the present day, but the above are the facts.

A FORGOTTEN MEDICAL CELEBRITY OF PARIS

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"*Véron, gorgé et repu de tout, disait quelquefois: 'Je manque des privations.'*"

EMBALMED in a volume of Sainte Beuve, the concluding four words of this citation constitute one of the best epigrams ever penned, Parisian wit *in excelsis*. The author must have been no ordinary being if, after a surfeit of all the good things of life, he could remain so good-natured and leave "the memory of a man unspoiled;" for the spoiling process usually makes a man a public nuisance. Who, then, was Véron? Why, no less than director of the Paris Opera during 1831–35; founder and editor of the *Revue de Paris* (1829–38); owner and director of the *Constitutionnel* (1838–52); author of the once popular *Mémoires d'un bourgeois de Paris* (1853–55); a member of the *Corps legislatif* (1852–62); the original producer of "Robert le Diable," "La Juive" of Halévy, Auber's "Bal masqué" and Taglioni's ballet "La Sylphide;" the man who persuaded Sainte Beuve to write the "Causeries du lundi" for the Monday *Constitutionnel;* whose funeral was as impressive as those of Meyerbeer and Rossini; and incidentally a graduate of the Paris Medical Faculty (1823) and a practitioner of sorts. Gay dog, *bon vivant* and festive Maecenas of the reign of Louis Philippe and the Second Empire, he is now as completely forgotten as the chamber music of Fesca, played by Parisians in the period when "La Muette de Portici" (1828), "Fra Diavolo" (1830) and "Les Huguenots" (1836) were novelties. As the Spanish proverb runs: "The dead have no friends." Yet when a careless scribe intimated that, within the Paris profession, Véron was regarded as "half a mountebank" (*moitié cabotin*), a lively tea-pot tempest was stirred up in the *Chronique médicale*. It transpired, from recollections of contemporaries still living, that he was really an efficient doctor on occasion, whose *jeux d'esprit*, in his great office of *médecin de l'opéra*, were to remedy the sprains of a Vestris or a Taglioni, the hoarseness of a Malibran, or to stop an "epidemic of ozæna in the ballet." Such deeds of derring do were, doubtless, of the

same "capital importance" as the discovery (by the brothers Goncourt) that the ballet girls cobbled their own slippers, which so perturbed Henry James in one of his Miss Nancy moods.

Son of a stationer, Louis-Désiré Véron (1798–1867) was primarily intended to be a publicist and was really a pioneer in the "scoop" methods of the modern newspaper man. Before he gave up practice in 1828, he had become rather a shameless advertiser of those simple prescriptions, beverages and dietetic dodges which, under high-sounding names, like Wells' Tono-Bungay, profess to fortify health and incite virility in the human frame. One of these was the *paté Regnauld*, for all diseases of the chest, into which Vèron boldly put his entire fortune of 40,000 francs, soon realizing an annual income of equal amount for a long time. As his caustic biographer (Caffe)[1] observes, "it led to the directorship of the opera, thence to journalism, thence to the legislative body, thence to novels fit for porters but read by many ministers of state." When he captured the sinecure of "Physician to the Royal Museums," Véron was laughed at as managing a practice limited to "the broken arms and legs of statues," and the chaffing went on for the rest of his life. When, at his own solicitation, Guizot named him Chevalier of the Legion of Honor, "for meritorious services to medicine" (1838), the nomination was opposed by the Duke of Orleans on the ground that so to decorate an ex-director of the Opera would "break down morale in the Army." Nevertheless, Véron got the cross in 1852. His parliamentary career ended when his constituents realized that his services were limited to voting with the ayes.

He was an infallible good guesser as to the ways of the jumping cat, supremely lucky all his life and unaffected by the ridicule which "in Paris kills only the unsuccessful and the unhappy" (Caffe).

[1] Caffe. *Jour. de conn. méd. et pharm.*, Par., 34:433; 464, 1867.

When he floated the foundering *Constitutionnel*, he deliberately used it to forward the candidacy of Napoleon III, both as to his presidency and the subsequent *coup d'état*, which he regarded as foregone conclusions. From his magnificent apartment in the rue de Rivoli, just opposite the Tuileries, Véron daily saluted the Emperor as he rode by. The salute was invariably returned, but Véron was never made a senator. In spite of wounded vanity, he would have been miscued for the magnifico rôle quite as much as the case adumbrated by the delightful Milt-Gross:

> De Souze,
> Wot he leeved in de bazement high het like a Tsenator,
> Tree gasses whooeezit—dot's right—it's de jenitor!

Or by one of the poets of his own time and place:

> Spadille. "Moi, j'ai l'air d'un marquis!"
> Quinola. Moi, j'ai l'air d'un ministre!"
> Irus (*les regardant*). Spadille a l'air d'une oie, et Quinola d'un cuistre!"

A bit chagrined, "Mimi Veron" gave up his newspaper and retired into private life, but continued to regard himself as a very necessary personage, held great receptions in his box at the Opera and treated coming and going politicians cavalierly.

Of lavish hospitality and princely generosity, he paid Eugène Sue 100,000 francs for the right to publish "Le Juif Errant," left about 600,000 francs to his relatives, a legacy of 30,000 francs to his housekeeper and a diamond snuff-box to his physician Ricord. His will stipulated that he was to be buried in a modest manner; but everybody followed his funeral to the church of St. Roch, which was draped in black, with music by a full orchestra, choruses from the Opera and subsequent discourses at Montmartre. After Véron's death, the journalists of Paris, remembering his kindness and hospitality, were a unit in declining to say anything against him. An odd character, worthy of a more extended study by some ocean-crossing M.D., who can investigate *in situ*—but he will have to know his Paris.

BOOK REVIEWS

Another of Springer's splendid productions, Die Erkrankungen der Schildruse.[1] Covers the entire subject of thyroid diseases (especially Goiter) from the viewpoint of Von Eiselbergs' clinic in Vienna. The specialist will find this book indispensable, though undoubtedly much exception will be taken to Breitner's classification. The ten page bibliography is preceded by a collective, critical abstract of the literature since 1924. This chapter is a distinct innovation and will be heartily welcomed. The absence of an index is to be regretted.

The appearance of each additional part makes one impatient for the completion of Die Chirurgie.[2] Part twenty-three, covering the joints, by authorities like Kroenig, Seifert and Stahnke of Wurzburg, is quite up to the standard set by the parts already published and gives further evidence of the splendid editing of Drs. Kirschner and Nordmann, who are producing a collection of monographs for the general surgeon that will rank with the best.

With the renewed interest in spinal anesthesia which is being evidenced throughout the country Doctor Evans' book[3] is timely. Physicians throughout the land are interested in this form of anesthesia and are giving it a trial in their operating rooms. Many surgeons are strong in their praises of "spinal," others employ it only casually, while others damn it, often without having given it clinical trials. Taken by and large there is much about spinal anestheisa, in the minds of many, clouded with scientific doubt. Many there are who are not familiar with its underlying principles, its physiology, its indications and contraindications, or its technique. Deaths from spinal anesthesia have been rumored and reported. In the great majority of instances a faulty technique is to be blamed and not the method.

Doctor Evans has covered the subject sanely and thoroughly. It is a readable book; it is authentic. When one has finished reading it he will be richer in his knowledge and look upon this method of anesthesia from a new viewpoint. It will pay every anesthetist and surgeon who has occasion, at any time, to resort to "spinal" to possess this book and spend an evening getting familiar with its contents. The whole story of spinal anesthesia is concisely told within its covers.

The Chapter headings are: Introductory; Selection of Patients; Induction of Spinal Anesthesia; The Various Drugs and Their Employment; Phenomena Accompanying Spinal Anesthesia; Possible Complications of Spinal Anesthesia; Care of the Patient; Routine to Insure Speed, Accuracy and Safety; Mortality, Morbility and an Analysis of Causes; Summary and Conclusions; Bibliography and an Index.

It is an important book offered the surgical members of the profession at a time when spinal anesthesia is being given another trial. The majority find it has a definite place in the surgical routine; many are thoroughly conversant with the subject; many try it casually and report failures. Dr. Evans' work is a needed addition to the surgical literature of the day.

Doctor Labat has done a noteworthy piece of work in writing Regional Anesthesia.[1] The second edition is proof of its popularity. It is needless to say that any surgeon who pretends to be classed as first grade must know about regional anesthesia or have someone in his clinic able to put it into practical application.

The book covers the method of regional anesthesia, its general principles and technic, blocking the cranial nerves, operations on the head, blocking the spinal nerves, genitourinary and rectal operations, operations on the lower extremities, subarachnoid block (spinal anesthesia), a discussion on subarachnoid block and a general discussion of the value of regional anesthesia.

The book is 567 pages in length, well indexed and illustrated. We earnestly recommend it to every surgeon.

Here[2] are three more books in the National Health Series, edited by the National Health Council. For small, practical books intended for the layman, we know of nothing that sur-

[1] Die Erkrankungen der Schildruse. By Burghard Breitner. Vienna, Julius Springer, 1928.

[2] Die Chirurgie. Edited by M. Kirschner, and O. Nordmann. Berl., Urban & Schwarzenberg, 1928.

[3] Spinal Anesthesia (Subarachnoid Radicular Conduction Block). Principles and Technique. By Charles H. Evans, M.D. Introduction by W. Wayne Babcock, M.D., F.A.C.S. Foreword By Charles Gordon Heyd, M.D., F.A.C.S. N. Y., Paul B. Hoeber, Inc., 1929.

[1] Regional Anesthesia. Its Technic and Clinical Application. By Gaston Labat, M.D. Foreword by William J. Mayo, M.D. Ed. 2. Phila., W. B. Saunders Co., 1928.

[2] Care of the Mouth and Teeth. By Harvey J. Burkhart, D.D.S. What Every One Should Know About Eyes. By F. Park Lewis, M.D., F.A.C.S. Diabetes and Its Treatment. By Frederick M. Allen, M.D. N. Y. Funk & Wagnalls Co., 1928.

passes or even equals these little booklets of which there are now almost thirty volumes on the market. The books are carefully written and edited and contain just the information that the average patient needs. Published at thirty cents each, they are available to everyone and it is to be hoped that they will have the large circulation they deserve.

Any book on biology that has introductions by Prof. Karl T. Compton and Prof. Raymond Pearl is worthy of note. But it does not, of necessity, follow that the author has found the final answer to "What Is Life?"[1] According to Professor Compton, the author's answer to the question purports to be based on "the facts of modern atomic physics."

If we have read the Associated Press dispatches from Berlin correctly "the facts of modern atomic physics" have been called somewhat into question by Professor Einstein and others. Far be it, therefore, from a mere reviewer to attempt to judge where experts differ; but Comptom's statement that "her discussion of modern atomic physics is accurate, well-balanced and worth reading for its own sake," would alone warrant the reading of the book by anyone seeking the answer to "What Is Life?"

According to Professor Pearl, "Mrs. Gaskell's hypothesis is capable of experimental test," which statement would seem to give the book the imprimature of scientific verity.

Mrs. Gaskell considers the electron the ultimate constituent of life, the variations occurring according to the manner of the combination of these constituents. Whether or not one agrees with the theories propounded by the author, the book will be found a great thought-stimulant and well worth the time given to its reading.

The keynote of this book[2] is the first sentence of the preface: "The aim of this handbook is to present in a practical manner the differential diagnosis of the commoner surgical affections." This the author has succeeded in doing and doing well. His further statement that "Throughout the book the author has had in mind the point of view of the student or practitioner, faced with a case of disease or injury" may also be accepted in toto. In handy format, well arranged with appropriate and easily found sideheads, this is a book for ready reference which should find a place in every surgeon's library.

This is a book[1] of over 900 pages covering the subject completely and yet concisely, and illustrated with the most unusual pathological plates in color for which credit is given to the *British Journal of Surgery*. The senior author is Hunterian Professor, Royal College of Surgeons of England. The book may be accepted as authoritative and up-to-date. By a clever system of cross reference duplication of material has been eliminated. It is all in all the best book on surgical pathology that has come to the reviewer's attention in years.

On the occasion of last year's 300th anniversary of the publication of William Harvey's epic-making work,[2] R. Lier & Co., of Florence, have issued a facsimile edition of the original. Like all publications of this house, this book leaves nothing to be desired typographically. Every medical man should have a copy of Harvey in his library and here is a perfect reproduction. It seems unfortunate that the publishers have limited themselves to reproducing only the original Latin. All the requirements of the Latin scholar are fulfilled, but the less erudite physician would undoubtedly profit by the addition of a translation. However, the beauty of this edition alone should lead many to looking up some of the splendid translations now available.

This book[3] covering the surgical aspects of tropical diseases and their complications should be invaluable to those coming in contact with such conditions. As the author states: "Tropical surgery includes every branch of ordinary surgery, but also demands a knowledge of some special aspects of surgery and various surgical diseases and complications rare or unknown in a temperate climate." In a 12mo volume of 300 pages, at a low price, the author would seem to have covered his subject well and as he is Professor of Surgery at the Medical College of Bengal and Surgeon to the College Hospital and also Examiner in Surgery at Calcutta University the book bears the stamp of authority.

[1] What Is Life? By Augusta Gaskell. Springfield. Charles C. Thomas, 1929.

[2] Handbook of Surgical Diagnosis. By Clement E. Shattock. N. Y., William Wood & Co., 1929.

[1] Surgical Pathology. By Cecil P. G. Wakeley and St. J. D. Buxton. N. Y., William Wood & Co., 1929.

[2] William Harvey's Exercitatio Anatomica de Motu Cordis, 1628 (facsimile edition). Florence, R. Lier & Co., 1928.

[3] Surgery in the Tropics. By Sir Frank Powell Connor, Phila., P. Blakiston's Son & Co., 1929.

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